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12
ON TEST

- Perfect for home & office
- Mystery £279 bargain
- Asus' new NUC for AI era



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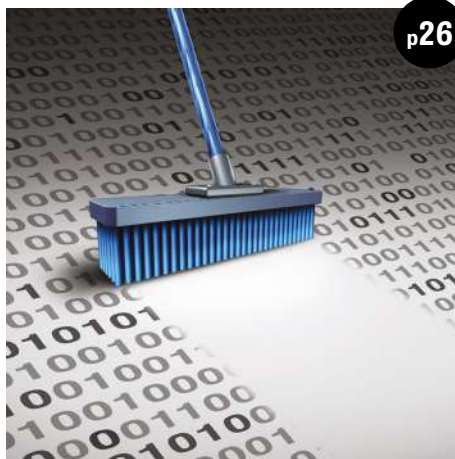
REVIEW OF THE MONTH

Lenovo ThinkBook Rollable Gen 6

If you've ever been frustrated while working on a laptop, thinking if only you had a little more screen space, then hold on to your hat. Lenovo's new 14in laptop turns into a 16.7in laptop thanks to a rollable screen. Press a button, and within seconds a motor will extend the viewable area upwards to give you a surprisingly huge boost: unfurled, it's equivalent to two 16:9 aspect ratio screens atop one another. We've given it a full, real-world test to see how it works in practice, and while we do uncover some drawbacks – and let's not talk about the price – there's a lot to love about it. Whether anyone buys it is another matter.



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WIPEOUT OF THE MONTH

Whether you recycle, downcycle or get rid of old laptops, PCs, tablets or phones, there's a good chance your data is still on there – unless you follow our advice.

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SHOW OF THE MONTH

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PROJECT OF THE MONTH

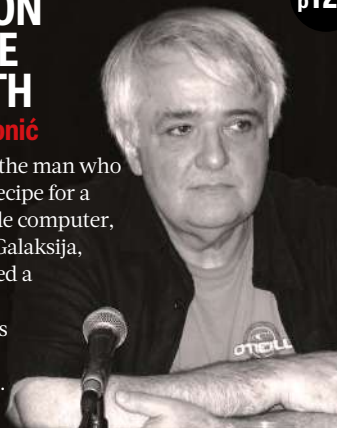
Our editor, not the most generous man, gave Nik Rawlinson £20 to build a home security system. Discover how he fared in his step-by-step guide, starting on p40.

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PERSON OF THE MONTH

Voja Antonić

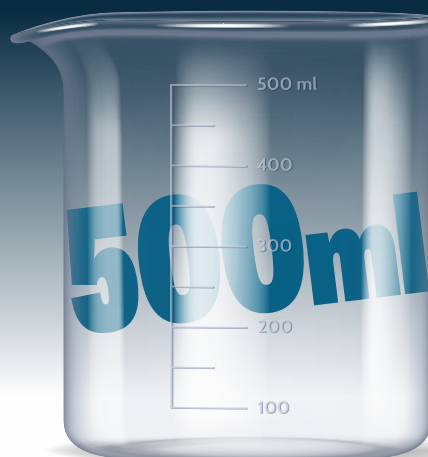
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PCs, Macs, phones,
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just might cry

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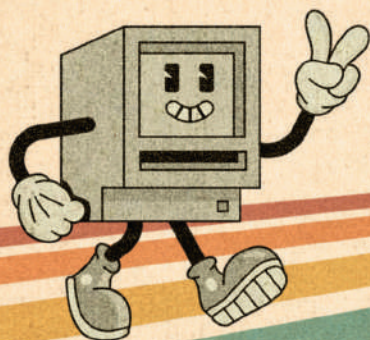


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 **PCSPECIALIST**



AI is back, and this time it's personal

It's the morning after. I'm battling typical hangover symptoms of headaches, mild nausea and deep-muscle fatigue, but this has nothing to do with an epic "night before". It's the first day after I left IFA 2025 in Berlin, where my only excesses were gorging on new launches, crawling every inch of IFA's showfloor and speaking to chipmakers.

Within a few hours of each other, I had informal, on-the-record but "please don't quote me directly" chats with a senior engineer from Intel and three key figures from AMD. Separately, they talked about the power demands of NPUs and how they plan to lower the AI-per-watt figure. This is one of their next big engineering challenges, where huge amounts of investment are going.

Is that an "I don't care about NPUs" at the back? Well, whether you like it or not, NPUs and thus locally run AI models will seep into your world. At home and at work. I'll make a bet that in five years' time it will be second nature to allow personalised, local AI agents to make decisions based on your data and preferences. And that's just the obvious application.

There's no escape. All the PC chipmakers, including Apple and Qualcomm, are committed to NPUs, which means that within two to three years they will be in pretty much every new device you buy. And that means the Adobes, Blenders and Ubisofts of this world will put them to use. All of which creates a virtuous circle: it means that if you *don't* have an NPU in your laptop or desktop PC, you'll be at a disadvantage compared to someone who does.

AI is changing the way companies create products, too. Embed a tiny chip into your device and you open up rich vistas of possibilities, and ones that can be upgraded by a relatively simple update of the learning model that sits behind it. Where the 4K camera on your gizmo was a set of dumb eyes before, it can now be married to a brain, giving it a whole bunch of tools – for example, recognition of who someone is and what they're doing. In a security camera, that means looking for intruders; in a tennis-ball machine, it means you can start playing rallies. This is the subtext of my show report from IFA, which starts on p32.

Of course, we'll also see a warehouse full of tat released as

companies struggle to produce products that solve genuine problems as opposed to jumping on the AI bandwagon. Smartglasses I actually want to use on a daily basis remain years away. Robots that perform useful tasks were once again entirely absent from the showfloor.

Then we come to the environmental cost. For years companies have gone big on net zero and their green credentials, but only Acer put this front and centre of its messaging at IFA – as mentioned in my interview with Acer's EMEA president, Emmanuel Fromont, which you'll find on p12. We must hold companies to account and flag when tech leaders such as Alphabet quietly abandon their net-zero pledges, as their AI data centres ramp up emissions.

Which may well be the reason why local AI eventually wins. Greater privacy, lower latency, but also less guilt: every time I give Google ImageFX a prompt I'm aware of the water and energy being consumed. How much better it would be if I could create something just as good, if not better, on my local PC.

Tim Danton
Editor-in-chief

CONTRIBUTORS



Simon Handby

We normally ask Simon to give us his verdict on printers (see p68), but this month he put a dozen mini PCs through their paces. Discover which he recommends from p78.



Jon Honeyball

If you're thinking about the Galaxy Z Fold7 we suggest you read Jon's thoughts after four weeks with the device. Plus he indulges in some "vibe coding". See the results from p110.



Rois Ni Thuama

Information security training is no yawning matter, explains Rois – and if it is then you're doing it wrong, which could have a disastrous effect. Step up in class by turning to p116.



Nicole Kobie

If you want to know your clankers from your glazings, you'd better turn to p126 and our "glossary of the future", where Nicole decodes all the latest tech jargon.

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Tying in with our feature on p26, we asked our contributors: what was the last item of technology you recycled or gave to someone else, and how did you make sure your data wasn't still on the device?

"I'm just about to despatch an Android phone to my Dad, so I'll be following Barry's advice to the letter!"

"I sold an old phone to Computer Exchange for a sad fraction of its original cost. I actually forgot to wipe it – the nice man at the counter reset it for me while I waited!"

"I downcycled an old laptop to my daughter for her school work. As it was staying in the family, I just used a quick Windows reset on the beast. She's not studying computing, so my secrets should be safe."

"I have an old smartphone that I lend to overseas visitors. I wipe and reset it, but it's only going to family and friends so data protection is less of a concern. The rise of eSIMs means I should probably send it in to be properly recycled, though."

"It was an old e-reader. Removing my data was easy – I unenrolled it from my account (hopefully that did the trick)."

"I recently donated a bunch of laptops to a teaching charity in Zambia. My usual process is to run KillDisk (killdisk.com) overnight on a multi-pass nuke strategy. For damaged drives where software erasure isn't possible, a liberal beating of the platters with a lump hammer or torching the NANDs with a hot air station can work equally well."

"It was an Apple Watch 1 Ultra. I did a full reset on it, but it went to Andre so wasn't going far."

"It was an old Surface Pro 5 I bought in 2017 that I gave to a neighbour just before the summer holidays. Back when I used the Surface Pro I used Google for everything, so all my data was synced to the cloud. I did a factory reset with a full drive clean and – bada boom, bada bing – wiped it."

"Chromebook to an animal charity. Factory reset, simples."

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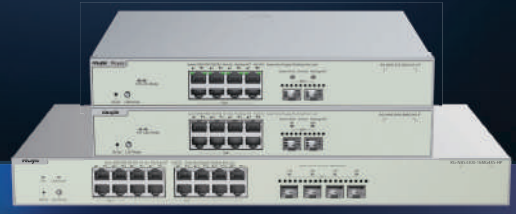
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Briefing

Background and analysis on all the important news stories

Google grapples with good cop, bad cop

Vastly differing remedies for anti-competitive behaviour in the US and the EU create huge uncertainty



Google's lawyers won't have had much time for the golf course recently. Just days after being handed what was widely regarded as a let-off for monopolistic abuse of the search market in the US, the company was threatened with a "structural remedy" by the European Commission for abusing its stronghold in online advertising, on top of a near €3 billion fine.

The wildly different approaches to taming big tech companies on either side of the Atlantic is creating uncertainty – and considerable hostility between the US and its European counterparts.

Are the big tech companies uncontrollable or will European regulators prove less malleable than their American counterparts?

■ Android intact

Google's good day in court came courtesy of District Judge Amit Mehta

from the District Court of Columbia, the same judge who only a year ago ruled that the company had illegally maintained monopolies in two markets: search and search text advertising.

Among the remedies being considered by the judge were Google being forced to sell off the Chrome browser or Android, but neither came to pass. Instead Google was forced to stop entering into exclusive deals for the distribution of its search, browser and AI assistants, and required to share some search data with "qualified competitors". It was about as light a touch as Google could have hoped for.

Why did the judge treat Google with such leniency? The judgment gave a clear insight into the judge's thinking, suggesting he was looking

more to the future than punishing Google for past misdemeanours.

"Courts must approach the task of crafting remedies with a healthy dose of humility," the judgment stated, adding that "unlike the typical case where the court's job is to resolve a dispute based on historic facts, here the court is asked to gaze into a crystal ball and look to the future. Not exactly a judge's forte."

Nevertheless, Judge Mehta's tea leaves told him that Google would face stiffer competition in the years ahead, negating the need to bring out the big hammer in his verdict. "The emergence of GenAI changed the course of this case," Judge Mehta stated. "No witness at the liability trial testified that GenAI products posed a near-term threat to GSEs [general search engines]. The very first witness at the



ABOVE Judge Amit Mehta let Google off lightly

remedies hearing, by contrast, placed GenAI front and centre as a nascent competitive threat. These remedies proceedings thus have been as much about promoting competition among GSEs as ensuring that Google's dominance in search does not carry over into the GenAI space."

Ben Wood, chief analyst at CCS Insight, told *PC Pro* there's "no question this is a positive outcome for Google", adding that being forced to peel off Android would have hurt. "Divesting Android would have been very damaging to Google," he said. "The operating system and wider platform is hugely valuable to the company, particularly in the context of getting its products and services directly into the hands of billions of smartphone users around the world."

Wood argues it might not have been AI that saved Android from divestiture, but Apple. "The judge also indicated his concerns that weakening Google's position with Android could be detrimental to consumers, as it could see Apple become even more dominant in the smartphone arena," he said. "Given that CCS Insight estimates that more than half of US smartphone users already have an iPhone, it is imperative that competition is sustained."

European defeat

If Google executives were quietly punching the air after Judge Mehta's verdict, they won't have been quite so ecstatic after the European Commission delivered its judgment on monopoly abuse in the adtech industry.

The highly technical judgment found Google (among other things) exploited its power by favouring its own ad exchange via its publisher ad server "to the detriment of its competitors, online advertisers and publishers". Advertisers consequently paid higher fees, which were passed on to consumers in the form of higher prices.

While Google might well consider the €3 billion fine as the cost of doing business, the strong implication that harsher punishments await may alarm the firm. The company was given 60 days to come back with a plan to end its illegal practices, but that's unlikely to include the break-up of the company that the



LEFT Google's Lee-Anne Mullholland said the EC fine was unjustified

European Commission is seeking.

"At this stage, it appears that the only way for Google to end its conflict of interest effectively is with a

structural remedy, such as selling some part of its adtech business," the Commission's executive vice-president Teresa Ribera said in a statement. "This seems both necessary and proportionate to effectively stop the infringement."

Google plans to appeal the verdict, with Lee-Anne Mullholland, the company's global head of regulatory affairs, arguing that it "imposes an unjustified fine and requires changes that will hurt thousands of European businesses by making it harder for them to make money".

“At this stage, the only way for Google to end its conflict of interest effectively is with a structural remedy, such as selling some part of its adtech business”

Turf war

The European Commission's fine certainly caught the attention of Donald Trump, who branded the verdict "very unfair" on his Truth Social network and stated that "we cannot let this happen to brilliant and unprecedented American ingenuity". He also threatened to initiate a trade probe that could lead to even greater tariffs on European goods.

Trump has, however, "let this happen" in America, too. It was his Department of Justice who instigated antitrust proceedings against Google in 2020, which concluded with Judge Mehta's ruling. And it's his Department of Justice that claimed a "landmark victory" in a second antitrust case against Google in April, which reached broadly similar conclusions to Europe in terms of Google's abuse of the online advertising market. The remedies hearing for that case was due to be heard just as *PC Pro* went to press.

Quite how Trump will react if the US courts decide to fine or break up Google's adtech business is anyone's guess. The ongoing uncertainty over whether the transgressions of the big tech companies will ever be dealt with continues.

Apple Airs new iPhone

Slender new iPhone revealed

Apple has extended its Air range of slimline products to the iPhone, among its latest batch of annual handset releases.

The 6.5in iPhone Air is the thinnest iPhone ever made, measuring only 5.6mm at its thinnest point. The entire body isn't 5.6mm thick, as there's still a sizeable bump for the camera housing, which contains only one 48-megapixel camera.

The reduced number of cameras may be a consequence of Apple squeezing as much of the phone's electronics into that camera bump as possible, so as to afford room for the battery inside. Apple hasn't revealed the precise capacity of the battery at the time of writing, but its own figures state the Air's battery will last for only 27 hours of video playback, while the standard iPhone 17 offers 30 hours and the iPhone 17 Pro offers 39 hours.

"The strategic positioning of the iPhone Air has a direct parallel with the launch of the MacBook Air in 2008 and the iPad Air in 2013, products that compromise on some specs to offer better portability and design," said Francisco Jeronimo, vice-president of devices at analyst firm IDC. "This new product targets a specific market segment that prioritises aesthetics, in-hand comfort, and portability over maximum camera capabilities or longer battery life."

Multiple cameras aren't the only victim of the Air's space saving. The iPhone Air is the first Apple phone to be eSIM-only on a worldwide basis, slamming another nail into the coffin of removable SIM cards. An entire handset has also made way for the iPhone Air, with Apple discontinuing its Plus range of iPhones to make way for the newcomer.

Jeronimo thinks it's a wise decision. "The new iPhone 17 lineup represents the biggest design overhaul since the iPhone X," he said. "In itself, this is a strong reason for users to upgrade."

The new iPhone range – which includes the regular iPhone 17, the iPhone 17 Pro and the Pro Max – did not come with an expected price rise. There was speculation that the steep US tariffs imposed on China and other Asian countries would force Apple to raise prices, but it's either managed to pre-load inventory, exert price pressure on suppliers or taken a diplomatic hit on its own profit margins.

BELOW The new range of iPhones sees "the biggest design overhaul since the iPhone X", say analysts



The Interview

Hard truths on green PCs

Emmanuel Fromont, Acer

We tackle Acer's EMEA president on everything from green promises to the success of AI PCs



What constitutes a “green” PC? Do consumers know what an AI PC is? And just how different are the consumer and business PC markets?

These are all issues we discussed with Emmanuel Fromont, president of Acer's EMEA (Europe, Middle East and Africa) operations in an exclusive briefing at the IFA trade show in Berlin in September. The Acer executive was refreshingly honest with his answers, too.

PC Pro: Acer's CEO Jason Chen spent the first ten minutes of his IFA presentation talking about environmental matters. Is that how you want Acer to be thought of, environment first?

Emmanuel Fromont: This is very deliberate. I think we've been very consistent on the [environmental] story. We really are careful not to do greenwashing, but to execute.

We often have questions saying “it looks like compared to the past, your focus on Vero [Acer's line of “green” laptops] is less”, because it's true we had a full lineup, several notebooks, now we have one. But we really cascaded the Vero concept and the Vero technology into everything.

So, in reality, yes – we still have a Vero that is pushing the product even further, because it's 70% PCR, it's net zero. We offset the remaining carbon, we ensure in the supply chain that it's produced with green electricity, 100%, but it's not easy to do with your entire supply chain. So Vero is still the flagship where we push the boundaries.

PC Pro: There are other things big companies such as Acer could do, such as copying the likes of Framework and making sure that parts are readily available for years down the line, and publish schematics.

Emmanuel Fromont: For every product, we publish carbon emissions. So, I think we are

“Everybody says everything should be modular, but people want thin products”

transparent on the carbon emissions for every single product now.

The schematics and others? In some products we try to get there. In Vero, we are more transparent. The rest, again, is a work in progress.

I'm honest here... you have this dilemma that is not just our dilemma, it is an industry dilemma. Consumers want you to be green,

but when you generally have cost in being green – in an industry like ours that is thin margin by nature – it's very, very difficult.

I think we always have to find those compromises. Everybody says everything should be modular, but people want thin products, so you melt the CPU on the motherboard and now you can't take your CPU. Sometimes we need to face those challenges. And it's a fact that in a very, very competitive industry it's all a matter of components.

PC Pro: And what about giving people a promise that they can actually get the spare parts in five years' time?

Emmanuel Fromont: The way we're organised, we do our own service. We have a hub in Poland. So we put a lot of spare parts in Poland that we diffuse later on in all the repair centres.

We know the legislation is forcing us now to say you have the right to repair. So, we really follow the laws. In some ways we like it because it's one thing to compete with my peers, but it's another to compete with a lot of people in the marketplace coming from a different country that are aggressive. And if the legislation can be the same for everybody, big organisations have more facilities [to handle repairs]. But we also need the lawmakers to see what's happening in the marketplace and force people who don't follow the law [to comply].

LEFT Acer's CEO Jason Chen was keen to push the company's green credentials in his presentation at the IFA trade show





So if there is more legislation, we're not fighting it, because the more complex it is, the more big organisations can handle complexity. But we need the law to be the same for everybody.

PC Pro: It's been about 18 months since you said Acer was making a big push into the business PC sector. How do you think it's going?

Emmanuel Fromont: The first half of the year was a little bit slow, to be fair. We see momentum now. The UK is a good example, if you look at our Context numbers, but we're coming from a low base. We start to see 40%+ or 50%+ [growth], but this is moving us from low percentage [of the overall market] to a little bit better percentage.

We need the channel. If you look at the announcements we made today on the TravelMate products, we said it's for SMBs and small businesses. We consciously know that sometimes big corporations have slightly different needs, and we're trying to focus where we can make a difference.

The goal is not to go after the big three. We need to use our own strengths.

PC Pro: Have you learned anything specific in the 18 months since you made that announcement?

Emmanuel Fromont: We learned that many of the target audience we have – SMBs, very small businesses – they can very well accept consumer products. So we're a little bit less strict in saying Aspire goes to consumer, TravelMate goes to pro. We're putting a lot more Aspire in the channel.

A lot of people go to a retailer and they see this beautiful Copilot+, that's what they need. They don't necessarily

need vPro or other features. So I think this is really working.

PC Pro: If you go to the Google website and look at the Chromeboxes, the last one was from 2023. You've announced two at this show alone. Why?

Emmanuel Fromont: We see more and more demand for products. It's mostly



ABOVE Acer announced two new Chromeboxes at IFA, its first such devices for two years

commercial use. There's more applications, the resilience of the OS is well known.

In the past, the challenge of ChromeOS versus Windows was legacy. If you have a lot of legacies, you are a little bit more careful of moving from one OS to the other. But we see more greenfield, more around AI. It doesn't need to be connected to a big infrastructure behind. Chromebox fits that pretty well. It's a lot of fun, less boxes, long duration and the demand is picking up for Chromeboxes.

PC Pro: Do you see the market for AI PCs picking up?

THE PC MARKET IN 2025: WHAT THE ANALYSTS THINK

The major analyst firms are surprisingly bullish about the global PC market in 2025, predicting a boost in sales. IDC revised its PC sales forecast for this year upwards in May, predicting that sales would grow by just over 4% year on year, despite the uncertainty created by US tariffs.

"Despite budget pressures on organisations, EMEA's traditional PC market is set to grow through Q2 2025 and beyond, driven by the end of Windows 10 support and Covid-era refresh cycles," said Malini Paul, senior research manager at IDC.

Context is also predicting growth, and gave some encouraging news on AI PCs in a recent blog post. The company's data shows that 35% of PC sales in Western Europe are AI-capable systems.

However, as Acer's Emmanuel Fromont concedes in the interview, that's not necessarily because of strong demand for these features from users. "Our analysis reveals this adoption stems from supply-side factors rather than demand-driven purchasing," the Context blog stated. In other words, the AI features are being built in, whether users want them or not.

Emmanuel Fromont: [I have] mixed feelings. Those PCs are fantastic PCs. The hardware inside is incredible. The battery life is seen as all-day, the hardware is really good. I think Windows 11 is a very good operating system.

But the notion that this is AI on the device versus AI in the cloud that you can have with almost any PC... I think as an industry, we did not do a good job in conveying that message to the end user. This still missing a little bit.

PC Pro: Is that because it's so hard to explain what the benefits of an AI PC are to users?

Emmanuel Fromont: It is hard. Of course, all the usage cases that were promised at the beginning in Europe are missing, like the [Windows] Recall function was never launched, and that was one of the major things. You have a lot of cool features, but people already believe I can do this on my phone. What is the difference?

I still believe those machines are definitely future proof. People will be happy to have them, because... you have more and more ISVs [independent software vendors] writing programs for the NPUs. So, you will start to have software, not just games, but basic software that – if they run on a new Copilot+ with NPU – they'll run better or differently, more features, more speed than on an old PC. ●

The A-List



The best products on the market, as picked by our editors

PREMIUM LAPTOPS

Apple MacBook Pro M4

M4 beast from £1,599

from apple.com/uk

This M4 update to the already brilliant MacBook Pro line is an easy recommendation, so the big question becomes do you choose the 14in version from £1,599 or 16in from £2,499? And then how much do you upgrade, as Apple isn't afraid of high prices. But whatever you choose should last for years, and look great while it's doing it.

REVIEW Issue 364, p50



BUSINESS LAPTOPS

Dell Pro 13 Premium

Sheer quality from £1,452 exc VAT

from dell.com

Dell's business laptop series has a new name, but its commitment to build quality and astonishing levels of configuration remain the same. Here, you benefit from a 1.1kg weight and 24-hour battery life, with Intel's 200V vPro series there for easier remote management. Just make sure you avoid the cheap screen option.

REVIEW Issue 368, p46



Apple MacBook Air M4

If you don't need the all-out power of the Pro, this is a brilliant, cheaper alternative despite the unchanged chassis and screen. **13in from £999, 15in from £1,199** from apple.com/uk

REVIEW Issue 368, p54

Honor MagicBook Art 14 (2025)

This slim 1kg laptop packs Intel's powerful Core Ultra 7 255H and a gorgeous 14.6in OLED touchscreen, yet survived for 12 hours in our light-use tests. And it looks gorgeous, too.

£1,500 from honor.com
REVIEW Issue 373, p59

Asus ProArt PX13

With AMD's new Ryzen AI 9 HX 370 inside, this 1.4kg compact powerhouse offers incredible amounts of power. Add a fantastic OLED screen and RTX 4070 graphics and it's a winner.

From £2,000 from uk.store.asus.com
REVIEW Issue 361, p50

Lenovo ThinkPad X1 Carbon Gen 13

The best executive laptop out there, with true all-day battery life even if you buy the 14in OLED version. At 1kg and with the latest components, it's worth the price. **From £1,875 exc VAT from lenovo.com**

REVIEW Issue 370, p52

Lenovo ThinkPad T14s Gen 6 (Snapdragon)

There's no better laptop if you want to try out Snapdragon, thanks to its combination of build quality, speed and battery life. **£1,500 exc VAT from lenovo.com**

REVIEW Issue 360, p56

HP OmniBook Ultra Flip

A top-quality 2-in-1 with a terrific 14in OLED panel, great build quality and superb battery life thanks to Intel's latest generation Core Ultra 7 processors. **From £1,699 from hp.com**

REVIEW Issue 365, p46

CREATIVE & GAMING LAPTOPS

Lenovo Legion Pro 7i Gen 10

RTX 50 power from £2,800

from lenovo.com

A surprisingly elegant chassis considering the power within, even if it still weighs 2.7kg. In return you get a 16in OLED panel, Intel Core Ultra 9 275HX CPU and, in our test system's case, and Nvidia RTX 5080 GPU. Lenovo simply doesn't put a foot wrong.

REVIEW Issue 370, p75



EVERYDAY LAPTOPS

Asus Vivobook S15

Copilot+ PC for £699

from currys.co.uk

This is one of the best-value laptops around, with an eight-core Snapdragon X Plus chip speeding things along in general use – albeit not in games. At 1.4kg it's extremely light for a budget 15.6in laptop and its battery life is excellent too.

REVIEW Issue 371, p83



Razer Blade 14

Our pick of the 14in gaming laptops thanks to its quiet running, gorgeous design and brilliant OLED panel. And the RTX 5070 graphics makes sense at this size.

RTX 5070, from £2,400 from razer.com

REVIEW Issue 372, p58

Asus ProArt P16 (2025)

Packing a RTX 5070, Ryzen AI 9 and brilliant 16in OLED panel into its slim, 1.9kg chassis, this is a fantastic choice for demanding creatives.

£2,800 from asus.com
REVIEW Issue 371, p60

Asus ROG Strix Scar 18 (2025)

Don't want to make any compromises? Choose this 18in monster, which weighs 3.3kg but extracts every drop from its components.

RTX 5090, £4,700 from asus.com
REVIEW Issue 370, p71

Acer Aspire Vero 16

An eco-friendly laptop due its use of PCR plastics, but more to the point a well-built and powerful 16in laptop that should last for many years.

£999 from currys.co.uk
REVIEW Issue 373, p60

HP OmniBook Ultra 14

If you have £999 to spend, consider the 16GB/512GB version of this cracking machine, with its aluminium chassis, 14in IPS panel and speedy Ryzen AI 365 CPU.

From £999 from hp.com
REVIEW Issue 371, p87

Microsoft Surface Laptop, 13-inch

Another laptop powered by a Snapdragon chip, but it's low power so this stylish laptop is best for less demanding tasks.

From £899 from microsoft.com
REVIEW Issue 371, p54

CHROMEBOOKS

NEW ENTRY

Lenovo Chromebook Plus Gen 10

MediaTek AI power for £549

from [lenovo.com](https://www.lenovo.com)

Simply the best Chromebook around thanks to a gorgeous 14in OLED screen and AI-enhanced skills courtesy of the MediaTek Kompanio Ultra 910 CPU. Add a well-built aluminium frame, 1.2kg weight and all-day battery life for the win.

REVIEW Issue 374, p54



Acer Chromebook Plus 516

If you can't afford the 15.6in Samsung Galaxy Chromebook Plus then Acer's Chromebook Plus 516 makes a solid but less beautiful alternative – as reflected in its price. The 15.6in screen provides plenty of space on which to work, and it proved a fast performer in our tests.

From £399 from [acer.com](https://www.acer.com)

REVIEW Issue 371, p90

Samsung Galaxy Chromebook Plus (2024)

The first truly desirable Chromebook since the Pixelbook, this is a top-quality laptop from the all-metal chassis to the 15.6in Full HD OLED screen. And thanks to Intel's Core 5 120U processor, it's fast enough to last for years.

£749 from [samsung.com](https://www.samsung.com)

REVIEW Issue 364, p65

MINI PCs

NEW ENTRY

NEW ENTRY

NEW ENTRY

Wired2Fire AMD R8845 Mini PC

AMD firepower for £600

from [wired2fire.co.uk](https://www.wired2fire.co.uk)

If you can live with a little noise, this mini PC is a revelation. Here's a sub-one-litre PC for £600 that can beat range-topping models from the major brands, with a generous base spec that you may never have to upgrade – but there's scope for it if you do.

REVIEW Issue 374, p88



Minisforum UM750L Slim

This brilliant mini PC offers solid everyday speeds for a price that looks like a typo. It's sensational value thanks to the AMD Ryzen 5 7545U processor, 16GB of RAM and a 1TB SSD in a small and quiet package, with the added bonus of low running costs.

£299 from [minisforum.uk](https://www.minisforum.uk)

REVIEW Issue 374, p86

Minisforum AI X1 Pro

Want power? The X1 Pro has it in spades, whether you buy the barebones system for £659 or the version we tested with 64GB of memory, a 1TB SSD bearing Windows 11 Pro and AMD's Ryzen AI 9 HX 370 processor. It's larger than the UM750L Slim but worth it.

£939 from [minisforum.uk](https://www.minisforum.uk)

REVIEW Issue 374, p87

ENTHUSIAST PCs

NEW ENTRY

Scan 3XS Edge iCue

Silent but deadly fast for £2,800

from [scan.co.uk](https://www.scan.co.uk)

With the RTX 5080 comes a refresh of best enthusiast PCs. The Scan is a shade slower than its Ryzen 9 9800X3D rival from Wired2Fire, but even at full pelt it remains astonishingly quiet.

REVIEW Issue 367, p50



CyberPower PC Ultra 3D5090

If you're after the fastest gaming PC you can buy for £4,000, let's make things easy for you: buy this. It's packed with speedy components, from AMD's Ryzen 9 9950X3D to RTX 5090 graphics to a 2TB Gen 5 SSD.

£4,000 from [tinyurl.com/370cyber](https://www.tinyurl.com/370cyber)

REVIEW Issue 370, p58

CyberPowerPC Ultra R5XT Gaming PC

This striking PC shines thanks to quiet running, AMD's fast Ryzen 7 9700X processor and 16GB Radeon RX 9060 XT graphics. With a 2TB SSD in tow, it's a great all-rounder for the money.

£1,349 from [cyberpowersystem.co.uk](https://www.cyberpowersystem.co.uk)

REVIEW Issue 374, p65

ALL-IN-ONE PCs

NEW ENTRY

Apple iMac M4

M4 power from £1,299

from [apple.com/uk](https://www.apple.com/uk)

Anyone hoping for a 27in iMac will be disappointed, but everyone else should be delighted by this M4-powered all-in-one with its 24in 4,480 x 2,520 IPS panel. It's fast inside and out, too, with Thunderbolt 4 and Wi-Fi 6E.

REVIEW Issue 364, p48



Lenovo Yoga AIO 27i Gen 10 (Intel)

This sturdy yet elegant all-in-one packs in everything most people need, including an Intel Core Ultra 7 255H processor, 16GB of RAM, a 1TB SSD and a solid 27in 120Hz IPS panel. The stand is height-adjustable, too, and this all-in-one PC even has light gaming potential.

£1,270 from [lenovo.com](https://www.lenovo.com)

REVIEW Issue 374, p59

Lenovo Yoga AIO 9i Gen 10

The first all-in-one Copilot+ PC is a superb evolution of Lenovo's gorgeous Yoga AIO 9i, with a 31.5in IPS 4K panel, Intel's "Lunar Lake" Core Ultra 200V processors and gaming prowess via RTX 4050 graphics as an option.

From £1,800 from [lenovo.com/uk](https://www.lenovo.com/uk)

REVIEW Issue 373, p63

CREATIVE WORKSTATIONS

NEW ENTRY

Scan 3XS GWP-A1-TR64

64-core 'ripper for £11,000 exc VAT

from [scan.co.uk/3xs](https://www.scan.co.uk/3xs)

Scan takes advantage of AMD's new 9000-series Ryzen Threadrippers, the 64-core 9980X, to deliver a monster of a workstation that topped almost all of our performance charts. It's helped by an RTX Pro 6000 Blackwell card and 128GB of memory. It's even a quiet runner.

REVIEW Issue 373, p93



Armari Magnetar MC64T9

Like Scan, Armari uses the latest AMD Threadripper silicon, this time the 32-core 9970X, to create a truly potent machine – with the assistance of 256GB of DDR5 memory and RTX Pro 600 Blackwell graphics. Simply a great workstation.

£10,995 exc VAT from [armari.com](https://www.armari.com)

REVIEW Issue 373, p90

HP Z2 Mini G1a workstation

Built around AMD's powerful Ryzen AI Max+ Pro 395 processor with 128GB of unified RAM, this versatile workstation can be used for everything from creative tasks to running LLMs with up to 128 billion parameters.

As reviewed, £2,280 exc VAT from [hp.com](https://www.hp.com)

REVIEW Issue 374, p60



TABLETS

Apple iPad Air M3

Languid power from £599
from apple.com/uk

It's hard to be too excited by this update as it's exactly the same design but with an M3 chip inside. But when the original was so damn good, whether in 11in or 13in variants, and Apple Intelligence is thrown in, it remains the best choice for the vast majority of tablet buyers.

REVIEW Issue 368, p56



Apple iPad Pro M4

The best tablet in the world becomes even better thanks to Apple's stunning M4 chip, a gorgeous OLED screen and the must-have accessory: the all-new Pencil Pro. But it comes with an obvious downside of cost, with the cheapest 13in incarnation costing £1,299. **From £999 (11in, 256GB) from apple.com**

REVIEW Issue 358, p48

OnePlus Pad 3

Not only the best Android tablet you can buy but a genuine rival to the iPads thanks to its support for Apple products via integrated file sharing and a Mac Remote Control feature. It's also fast, packs a superb 13.2in screen and comes with a fine array of accessories. **From £529 from oneplus.com**

REVIEW Issue 371, p62

EVERYDAY PHONES

Google Pixel 9a

Why pay more? From £499
from store.google.com

If you can live without an optical zoom then it's hard to think of a reason to pay more for a phone. The AI features are genuinely useful, it's fast, the battery lasts forever, the camera is superb and the 6.3in OLED panel is a joy to gaze at.

REVIEW Issue 369, p74



Nothing Phone 3a

Looking to get the best possible phone for around £300? This is it. Quite aside from Nothing's unique design, it features a gorgeous display and high-quality cameras – including an optical zoom that few phones in this price bracket can match.

£329 from nothing.tech

REVIEW Issue 368, p77

Honor 400

This is a luxury phone without the luxury price. Taking many cues from the iPhone's design, including its software, the Honor 400 packs a 6.6in AMOLED panel, high-quality 200MP main camera and a mid-range Snapdragon processor. It's great value.

256GB, £400 from honor.com

REVIEW Issue 371, p72

PREMIUM PHONES

NEW ENTRY

Samsung Galaxy S25 Ultra

AI in your hand from £1,249
from samsung.com/uk

So good it tempted our reviewer – an iPhone devotee – to move to the other side. That's thanks to the faultless hardware, brilliant photography performance and Samsung's slick AI, not to mention the integrated S Pen stylus. It's not cheap, but you're buying for the long term with seven years of OS updates.

REVIEW Issue 367, p70



Samsung Galaxy Z Fold7

The price sticks in our craw and we miss the S Pen support, but Samsung has absolutely nailed the foldable phone at its seventh attempt. It's slim, sturdy, super-fast and it packs cameras so good that – optical zoom aside – this phone's photos are almost inseparable from the S25 Ultra.

256GB, £1,799 from samsung.com

REVIEW Issue 372, p48

Google Pixel 10

An extremely tempting alternative to the Pixel 10 Pro as the plain Pixel now includes the same 5x optical zoom camera, many of its brother's AI features and Google's answer to MagSafe, known as "Pixelsnap". And it comes in more interesting colours, too. Both are great, but why pay £200 more?

£799 from store.google.com

REVIEW Issue 374, p74

24IN TO 27IN MONITORS

BenQ DesignVue PD2730S

5K + Thunderbolt, £1,000
from scan.co.uk

A great choice for creative professionals and demanding users alike, and if your budget can take it why not daisy-chain two together over Thunderbolt? You'll love the image quality and 5K resolution.

REVIEW Issue 372, p89



Asus ZenScreen Smart Monitor MS27UC

This stylish 27in monitor packs a high-quality 4K screen, but where it distinguishes itself is by loading Google TV and great speakers to turn it into a great choice for those who need to work and play. **£399 from argos.co.uk**

REVIEW Issue 372, p88

Iiyama ProLite XUB2797QSNP-B1

This 1440p monitor may lack the luxuries of its A-List brethren, but you can't argue with the quality of the panel, nor the connectivity – with an RJ45 port, this is a true docking monitor.

£237 from iiyama-monitors.co.uk

REVIEW Issue 372, p84

32IN+ MONITORS

Iiyama ProLite XCB3497WQSNPH

Curved quality, £380
from scan.co.uk

All three displays here use curved 34in panels with a 3,440 x 1,440 resolution. Despite an aggressive price the ProLite packs everything you need including RJ45 networking and a KVM.

REVIEW Issue 372, p93



MSI Modern MD342CQPW

You won't find RJ45 networking here – as expected to hit the bargain price – and others go brighter, but this 34in curved, white monitor delivers terrific colour coverage, a decent pair of speakers and USB-C docking in a stylish casing.

£299 from currys.co.uk

REVIEW Issue 372, p91

Philips 34B2U6603CH

This monitor packs in every feature we can think of: Thunderbolt 4, daisy-chaining, excellent 5W speakers, 2.5GbE networking and a high-quality webcam. The cheaper ViewSonic VG3457CV beats it for clean whites, but the Philips is a better all-rounder.

£559 from uk.insight.com

REVIEW Issue 372, p92

WEBCAMS

Logitech MX Brio 705 for Business

Consistent brilliance for £219

from [logitech.com](https://www.logitech.com)

Consistent image quality in all lighting conditions coupled with top build quality and nifty features – such as a presenting mode for items on your desk – make this a fantastic all-round choice.

REVIEW Issue 356, p68



Logitech Brio 105 for Business

While you can buy 1080p webcams for a third of the Brio 105's price, they won't hold a candle to the Logitech webcam's quality – especially in low-light conditions, such as one candle. It's also easy to manage, for businesses and individuals.

£45 from [logitech.com](https://www.logitech.com)

REVIEW Issue 360, p77

Obsbot Tiny 2

This portable 4K webcam delivers for quality, design and sharpness, and it comes with a shedload of advanced features, including dynamic zoom and subject tracking. The only real downside is that it has a price that reflects its premium ambitions.

£329 from [amazon.co.uk](https://www.amazon.co.uk)

REVIEW Issue 352, p75

HOME OFFICE PRINTERS

HP OfficeJet Pro 9135e

Do-it-all inkjet for £193

from [printerbase.co.uk](https://www.printerbase.co.uk)

This versatile inkjet all-in-one – which includes a 35-page ADF – pumps out high-quality prints at laser-rivalling speeds. Likewise scans and copies. Print costs are reasonable, too.

REVIEW Issue 365, p85



Epson EcoTank ET-2865

As usual with ink tank printers, you don't get many frills with the Epson EcoTank ET-2865 (so no ADF or screen). What you do get is incredibly low running costs of 0.5p for colour and 0.2p for mono, plus high-quality prints and scans.

£233 from [uk.insight.com](https://www.uk.insight.com)

REVIEW Issue 365, p84

Canon i-Sensys LBP243dw

Everything you could want from a mono laser printer – it doesn't come with a scanner – the LBP243dw produces excellent results at speed. You also get Wi-Fi and wired networking.

£186 from [printerbase.co.uk](https://www.printerbase.co.uk)

REVIEW Issue 365, p88

WORKGROUP PRINTERS

Canon Maxify GX6550

Ink tank all-in-one for £392 exc VAT

from [canon.co.uk](https://www.canon.co.uk)

Designed to fit in tight spaces, this all-in-one includes a highly effective ADF and backs it up with high-quality prints at 24ipm in our tests. Running costs are superb, too.

REVIEW Issue 350, p58



Brother HL-L9430CDN

This laser printer (not an all-in-one, so there's no scanning or copying functionality) is a great choice for a busy office, producing sharp black text and making a good job of colour graphics as well. All while doing so quickly with a competitive price per page.

£415 exc VAT from [printerland.co.uk](https://www.printerland.co.uk)

REVIEW Issue 353, p84

Xerox B315DN

A fine alternative to the Brother and Canon, this mono laser multifunction printer produces superb results at great speed – 27.5 pages per minute in our 50-page test, which includes the spool time. It's similarly quick for scans, with a dual-CIS ADF to speed up double-sided copies.

£238 exc VAT from [printerbase.co.uk](https://www.printerbase.co.uk)

REVIEW Issue 341, p87

WIRELESS ROUTERS

Netgear Nighthawk RAXE300

Fast Wi-Fi 6E router, £350

from [amazon.co.uk](https://www.amazon.co.uk)

The RAXE500 is faster than the RAXE300, but in practice we doubt you would notice – this tri-band router still delivered speeds between 50MB/sec and 150MB/sec in our tests. And it's packed with features, too. At £150 cheaper than its bigger brother, we think it hits the Wi-Fi 6E sweet spot.

REVIEW Issue 341, p68



TP-Link Archer BE550

At almost half the price of the Netgear Nighthawk RAXE300, this is a brilliant mid-range choice thanks to a 6GHz radio and five 2.5GbE ports – you'll enjoy superb wired and wireless performance, and it even comes with a wide set of features.

£180 from [amazon.co.uk](https://www.amazon.co.uk)

REVIEW Issue 371, p70

Asus RT-BE58U

A great deal for those on a tight budget, this dual-band Wi-Fi 7 router (there's no 6GHz radio) performed well in our 5GHz tests at a price that can't be beaten. You can even enable MLO across the 2.4GHz and 5GHz bands.

£99 from [amazon.co.uk](https://www.amazon.co.uk)

REVIEW Issue 371, p70

MESH WI-FI

TP-Link Deco XE200

Clever Wi-Fi 6E for £400

from [amazon.co.uk](https://www.amazon.co.uk)

There are cheaper Wi-Fi 6E meshes, but the XE200 wins for its superb download speeds, excellent coverage and the fact that older clients reap benefits of 6E, not just new ones. And a two-pack (code BOBKTDPC8) should be enough for most premises.

REVIEW Issue 349, p65



Netgear Orbi 770

If you're eager to upgrade to Wi-Fi 7 then the Orbi 770 is the best mesh option yet. Its speed and range are both excellent, with a twin-pack covering 420m² (says Netgear), and the wired connectivity superb: four 2.5GbE connectors on the router unit, two 2.5GbE ports on the satellites. But it ain't cheap.

2-pack, £600 from [amazon.co.uk](https://www.amazon.co.uk)

REVIEW Issue 364, p70

Linksys Velop Pro 6E

Ironically, this Wi-Fi 6E router will get the most out of your non-Wi-Fi 6 devices thanks to its use of the 6GHz network for station-to-station traffic. And you only need two units for rock solid performance across a three-bedroom house.

2-pack, £380 from [amazon.co.uk](https://www.amazon.co.uk)

REVIEW Issue 350, p54



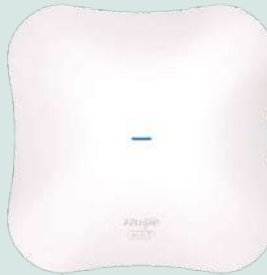
BUSINESS WI-FI

Ruijie Reyee RG-RAP73Pro Wi-Fi 7 AP, £201 exc VAT

from broadbandbuyer.com

The RG-RAP73Pro delivers a wealth of features and top Wi-Fi 7 performance at a tempting price. Broadbandbuyer's provisioning service makes light work of deployment, and the free Ruijie Cloud service offers top-notch remote management.

REVIEW Issue 369, p103



TP-Link DR3650v

"Business Wi-Fi" doesn't do justice to this all-in-one communications, security and networking solution, which combines a dual-band AX3000 access point with WAN redundancy, failover services and a treasure trove of features. **£208 exc VAT** from broadbandbuyer.com

REVIEW Issue 368, p103

DrayTek VigorAP 905

The VigorAP 905 is ideal for businesses seeking a well-endowed Wi-Fi 6 AP with top-notch wireless meshing support. It's a breeze to deploy, wireless performance is good, and a price of only £83 makes it outstanding value. **£83 exc VAT** from broadbandbuyer.com

REVIEW Issue 372, p102

NAS SERVERS

Synology DiskStation DS1823xs+

10GbE NAS, £1,413 exc VAT

from broadbandbuyer.com

This stalwart retains its top spot on the A-List thanks to its powerful performance (courtesy of a Ryzen chip), huge capacity via eight LFF/SFF hot-swap SATA bays and an unmatched set of business-friendly apps. And it's all built on Synology's DSM 7.2, which is focused on data security.

REVIEW Issue 368, p99



Asustor Nimbustor 4 Gen2 AS5404T

Built for SMBs and enthusiasts who demand the best performance, the AS5404T is a four-bay NAS that offers much more than most, with some nice surprises under its standard-looking exterior.

£441 (£529 inc VAT) from amazon.co.uk

REVIEW Issue 369, p88

Qnap TS-264

The Qnap TS-264 is aimed at those who want a bit more from a traditional two-bay NAS. It's effectively the two-bay version of the excellent four-bay TS-464, and like its sibling provides strong speeds over its pair of 2.5GbE ports – and includes two M.2 NVMe slots.

£391 (£469 inc VAT) from [ukstore.](https://ukstore.qnap.com)

qnap.com

REVIEW Issue 369, p86

VIDEOCONFERENCING

Biamp Parlé VBC 2800 Go big for £2,918 exc VAT (MSRP)

from midwich.com

We thought the VBC 2500 was a great VC room bar, and the new VBC 2800 delivers Biamp's undeniable expertise to larger meeting rooms. Video and audio quality are outstanding, speaker framing is super fast and the smart combination of dual camera lenses makes sure everyone is in the big picture.

REVIEW Issue 364, p98



Owl Labs Medium Room Solution

The Owl 4+ and Owl Bar partnership offers smart tracking and dynamic split-screen views to ensure everyone is in the picture, while the Whiteboard Owl adds extra professionalism to presentations and training sessions.

Owl 4+, Owl Bar, TV mount, £2,999 exc VAT from owllabs.co.uk

REVIEW Issue 364, p100

Ricoh Meeting 360

Ricoh's Meeting 360 is up against stiff competition in the panoramic meeting hub market but stands out for its excellent build quality and generous three-year warranty. It's easy to use and delivers good video and audio quality, while the smart app allows you to create a view for every occasion.

£744 exc VAT from amazon.co.uk

REVIEW Issue 364, p101

SCANNERS

Brother ADS-4900W

60ppm for £529 exc VAT

from tradescanners.com

An incredible range of features at a competitive price. Scan speeds are even faster than the quoted 60ppm, output quality is excellent and top-notch software and apps deliver a wealth of options.

REVIEW Issue 370, p98



Ricoh fi-8040

Ricoh's fi-8040 offers SMBs a remarkable range of features for a great price. Output quality is beyond reproach, it delivers on its 40ppm promises and the multiple operational modes make it highly flexible. **£249 exc VAT** from thescannershop.com

REVIEW Issue 370, p101

Canon imageFormula DR-S350NW

You don't need to install this affordable networked desktop scanner, which almost hit 55ppm scan speeds in our test. Canon backs it up with a fine software package. **£433 exc VAT** from printerland.co.uk

REVIEW Issue 370, p99

SECURITY APPLIANCES

DrayTek Vigor C510ax Unbeatable redundancy for £447 exc VAT

from broadbandbuyer.com

Ideal for SMEs and remote sites that need always-on internet access. It's packed with WAN redundancy features, the latest DrayOS 5 software delivers a wealth of features, and it all comes at a great price.

REVIEW Issue 372, p99



Zyxel USG Flex 50HP

Don't be fooled by its size: Zyxel's USG Flex 50HP packs in an impressive set of security services for the price. It's ideal for protecting small offices and remote sites, and the slick Smart Sync feature means never having to choose between local or cloud management.

Appliance with 1yr Gold licence, £316 exc VAT from store.zyxel.com

REVIEW Issue 372, p101

WatchGuard Firebox T85-PoE

A powerful gateway security package ideally suited to protecting large remote sites. Licensing schemes are easy to understand, and WatchGuard's cloud portal makes light work of remote management. **Appliance with 3yr TSS subscription, £4,284 exc VAT** from broadbandbuyer.com

REVIEW Issue 372, p100

SECURITY SOFTWARE

Avira Prime

Avira wins for all-round AV performance, plus a solid VPN, for a fair price. Watch out for a second-year hike to £91, though. **First year: 5 devices, £52 from avira.com**
REVIEW Issue 366, p84



Bitdefender Total Security

A long-term award winner in our security suite Labs, Bitdefender continues to charm for its consistent AV performance, solid feature set and extremely competitive price. **5 devices, 1yr, £20 from store.pcpro.co.uk**
REVIEW Issue 366, p85

Avira Free Antivirus

There's absolutely no need to pay for a full security suite if you only want antivirus protection, and Avira is our top choice simply due to its excellent and consistent performance in tests. **Free from avira.com**
REVIEW Issue 366, p89

VPNs

ExpressVPN

Blistering speeds, outstanding region-shifting performance and a good track record on security mean this VPN is worth the expense. **2yr 4mth \$140 (£113) from expressvpn.com**
REVIEW Issue 370, p84



Mullvad

A consistent performer with consistent pricing – there's no need to sign up for the long term as it costs only €5 per month as a flat rate – but not the best choice for region shifting. **€5 (£4.34) per month from mullvad.net**
REVIEW Issue 370, p85

Proton VPN Free

While Proton's VPN Plus is also a great choice, if you're looking for a freebie then choose this VPN for its fast connections (or alternatively Windscribe if you need to choose territories). **Free from protonvpn.com**
REVIEW Issue 370, p89

LINUX DISTROS

Ubuntu

A fine choice for Windows switchers thanks to its familiar design, with regular six-monthly updates and a Long Term Support version. **Free from ubuntu.com**
REVIEW Issue 367, p92



Fedora Workstation

One of the longest-established distros, and with a strong link to Red Hat Enterprise Linux, Fedora Workstation will particularly appeal to business migrators. **Free from fedoraproject.org**
REVIEW Issue 367, p85

Linux Mint

There's a good reason this is a popular choice for Windows 10 refugees, including a familiar "Start menu", and it's easy to give it a trial before committing. But consider Zorin OS, too. **Free from linuxmint.com**
REVIEW Issue 367, p86

CLOUD BACKUP

IDrive Business

An incredibly affordable hybrid backup solution. It's easy to deploy, supports Google Workspace, Microsoft 365, Dropbox and Box, and is ideal for protecting remote and on-premises systems. **5TB, £791 exc VAT per year from idrive.com**
REVIEW Issue 371, p100



NETWORK MONITORING

Progress WhatsUp Gold 2024

A great SMB choice as it presents a clear picture of your network and is available in a wide range of licensing plans. It's a cinch to deploy, doesn't require a lot of host resources and the new features make it even easier to customise. **Enterprise, 50 devices, £1,177 exc VAT per year from whatsupgold.com**
REVIEW Issue 366, p100



VOIP SERVICES

3CX Phone System 20 Update 5

Deployment options are extensive, call-handling features are excellent and, although you'll need to source an SIP trunk, 3CX's Phone System 20 is very affordable. **Enterprise, 8SC, £385 exc VAT per year from 3cx.com**
REVIEW Issue 369, p98



Barracuda Backup Vx

This affordable virtualised on-premises backup solution is easy to deploy on VMware or Hyper-V hosts and integrates local and cloud backup. **From £804 exc VAT per year from barracuda.com**
REVIEW Issue 371, p99

Park Place Technologies Entuity 22

An impressive toolbox of monitoring services all easily managed from a web console that offers a wide range of informative dashboards. **From \$150 per node/year from parkplacetechnologies.com**
REVIEW Issue 366, p99

TelephoneSystems.Cloud

Ideal for businesses that don't want any unpleasant billing surprises, with an impressive range of call-handling features. **From £11 exc VAT per user per month from telephonesystems.cloud**
REVIEW Issue 369, p100

BUSINESS BACKUP

NEW ENTRY

Arctera Backup Exec 25

SMBs seeking affordable data protection for physical and virtual environments will love Arctera's Backup Exec 25. The licence plans are easy to manage, it offers essential ransomware protection and introduces plenty of new features. **Simple Core Pack, 5 instances, £612 exc VAT per year from senetic.co.uk**
REVIEW Issue 374, p99



REMOTE SUPPORT

IDrive RemotePC Enterprise

Large businesses that want a flexible and feature-rich cloud-hosted support solution will love RemotePC Enterprise. It provides technicians with a wealth of support tools, access security is tight, and IDrive's simple licensing plans are superb value. **First year, 100 PCs, £329 exc VAT from remotepc.com**
REVIEW Issue 373, p99



CLOUD FILE-SHARING

Progress ShareFile Premium

Progress ShareFile Premium will appeal to SMBs seeking affordable and easily managed cloud collaboration services. It offers plenty of app integrations plus support for large file sizes, and the AI-powered features deliver smart security measures. **£19.90 exc VAT per user per month billed yearly from sharefile.com**
REVIEW Issue 367, p98



Nakivo Backup & Replication 11

NEW ENTRY

Supports more host platforms than rivals, has a range of affordable licence plans, and delivers data protection and ransomware protection. **Enterprise, 5 servers, perpetual, £937 exc VAT from nakivo.com**
REVIEW Issue 374, p101

Zoho Assist Professional

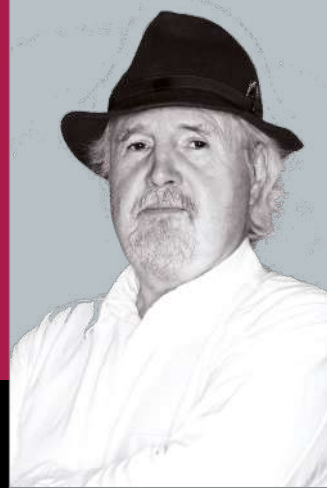
Assist lives up to its name: it's easy to use and manage, offers a wealth of support features, and licensing plans are flexible. **£12 exc VAT per month/technician billed yearly from zoho.com/assist**
REVIEW Issue 373, p101

Dropbox Business Plus

Collaboration tools, app integrations and a huge maximum file size limit – plus malware scanning and data classification – make this a great choice. **£18 exc VAT per user/month billed yearly from dropbox.com**
REVIEW Issue 367, p96



Controversial Haidt is hard to love



Dick Pountain is editorial fellow of *PC Pro*. He likes ChatGPT, but in a purely platonic way. dickpountain.co.uk

Sorry, OpenAI – you'll never achieve AGI unless you can inject machines with the mish-mash of emotion and biology that define human intelligence

It becomes harder and harder to scrabble grains of pleasure, amusement or edification from the internet, but it remains possible (just) on YouTube. I particularly enjoy two grizzled performers, Rick Beato – whose interviews with musicians such as Rick Rubin, Guthrie Trapp and Tom Bukovac are priceless – and Jon Stewart, the satirical commentator whose *Daily Show* kept many of us in stitches during the George W Bush presidency. Stewart tried to retire in 2015, but he's now returned, presumably lured by the grim shenanigans in the White House. He presents a YouTube version of the *Daily Show* on Mondays, and on Thursdays he hosts an in-depth podcast called *The Weekly Show*, on which a recent guest was the social psychologist Jonathan Haidt.

Haidt's best-selling book suggests that smartphone overuse is damaging young people's mental health. I know his work from reviewing an earlier book called *The Righteous Mind*, published in 2012 – a study of the way a person's moral outlook affects their political behaviour. Haidt is a leading light of the "Intuitionist" school of psychology, which holds that not all our behaviour is rational, and that moral judgements such as disgust are hard-wired to bypass the reasoning parts of the brain. His experiments that test this are highly amusing but unsuitable for a family magazine like this, since they involve ideas of incest and molesting chicken dinners.

I raise his work because it relates to another book I've just reviewed: Karen Hao's *Empire of AI*, an inside glimpse into the rise of OpenAI and ChatGPT. Hao documents three important facts

about OpenAI: unanimous agreement that artificial general intelligence (AGI) is possible and the only worthwhile goal; belief that AGI will be achieved by endless scaling, cramming millions of Nvidia GPUs into its servers; and a split, right from the very start, between those who think AGI will be great and those who think it will be deadly. Personally, I believe AGI is neither desirable nor possible, for reasons that depend upon the work of Haidt, among others. If it's not achievable, that means we needn't fear enslavement by robots, but also the current monomaniacal hyperscaling is futile and wasteful.

Impressive, amusing and addictive as current AI systems are, they fall far short of general intelligence as they're not alive. Unlike Nvidia chips, living beings need food, safety and to reproduce, and these imperatives structure our thoughts and behaviours. Billions of years of evolution have equipped us with "emotions", chemical computational sub-systems that detect and seek to satisfy needs. Portuguese neuroscientist Antonio Damasio postulates that when we store a memory of an event it gets imprinted with our emotional/hormonal state at the time (via biochemistry that is barely yet understood). When we retrieve it later to help understand some future event, these emotional markers act as weights – like parameters in an LLM – and contribute to the outcome of our decision.

To us, therefore, images and words are never entirely neutral: they carry subconscious emotional connotations of varying strengths. AI models lack needs and fragile bodies, and hence purpose. Actually, smartphones, which can "see" and "hear", know their location and orientation and travel the world in our pockets (so long as we remember to charge them), are way closer to human experience than ChatGPT is.

“To us, images and words are never neutral: they carry subconscious emotional connotations. AI models lack needs, and hence purpose”

Equipping one of those highly capable Boston Dynamics robots with a fully autonomous AGI must remain science fiction so long as GPTs require aircraft-hangar-sized supercomputers and consume megawatts of electricity. Our own bodies have a mitochondrial "battery" in every cell, enabling us to think and/or reproduce ourselves on around 2,000 calories a day.

Cognitive psychologists such as Haidt show that emotional modes of intuitive thought aren't reducible either to symbolic logic or Turing computability, yet it is these mechanisms that underpin crucial affective human virtues such as empathy, wisdom, justice, courage, honesty, compassion and generosity, without which any aspiring AGI would merely be a sociopathic silicon solipsist. Most importantly, intuition is vital for creative reasoning, causing those unprecedented leaps between vastly differing conceptual spaces that make up the mind of a Newton, a Mendelev or an Einstein.

Yet training data for connectionist AI models contains only *representations* of mental states – text and pictures scraped from the internet – and what emotional weight it does aggregate is mostly bad news, a swamp of hateful human communication that costs the AI firms big bucks to hire human beings to painstakingly disinfect. They call these procedures "alignment" and RLHF, or reinforcement learning from human feedback. I will quietly draw your attention to the word "human" in that phrase, and leave it there.

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“Impressive, amusing and addictive as current AI systems are, they fall short of general intelligence”

Put on your headphones – sometimes



Nicole Kobie is PC Pro's Futures editor; she genuinely does use an adapter to connect headphones to her iPhone, even when jogging, like some sort of ancient person.
X@njkobie

Playing music out loud in public spaces is annoying and selfish, but not as foolish as ignoring the rest of the world

Put your headphones in, pull your headphones out – it's not the hokey cokey, as you Brits call it, it's modern life. Getting the etiquette right on headphones is clearly beyond most people, and yes, I am aware how old and crotchety I sound right now.

It would seem I'm not alone in my annoyance at music being played out loud in public. To battle the scourge, Transport for London (TfL) is asking people to behave better.

I blame this on Apple AirPods, which – again, like I'm 99 years old – I refer to as "EarPods". In an age of wireless ear-hole fillers, traditional headphone jacks have mostly disappeared from smartphones, and that means if your EarPods run out of charge, or if you can't figure out how Bluetooth works, your only recourse is to play your TikToks out loud on the bus. Or buy an adapter for corded headphones, but no one seems to do that aside from me.

In fact, this issue dates back long before AirPods. In 2005, Gervase de Wilde, writing in the *Daily Telegraph*, was lamenting the rise of "those little white headphones", referring to the corded kind for the iPod. However, the reason may surprise you: de Wilde was

“Getting the etiquette right on headphones is beyond most people, and yes, I am aware how old I sound”

sad that music wasn't being shared any more. He expressed the hope that "the trend for playing music out loud will surely spread away from its earliest adopters on my London bus... to any spaces where people come together."

That collective musical experience might happen, he predicted, with the arrival of the rumoured "iTunes Phone" complete with speakers. Well, he was right that it would spread, anyway. And people have become so annoyed

about it that TfL has now launched an initiative called "Turn it off, keep it down," with posters discouraging playing music out loud. Oh wait, that was in 2007. Similar posters against "sodcasting" hit London's transport network again in 2010, as part of the "Considerate Travel" campaign.

Clearly, these campaigns don't work, as here we are again with a fresh one from TfL targeting what we now apparently call "bare beating" – although I don't think that atrocious bit of tabloid slang is any more likely to catch on than "sodcasting".

Given the general failure of such campaigns, it's no surprise that some people have even suggested fining offenders, with the Liberal Democrats demanding a £1,000 fine for bothering others with music. The party's home affairs spokesperson, Lisa Smart, explained: "Far too many people dread their daily commute because of the blight of antisocial behaviour – and headphone dodgers playing loud music on buses and trains are some of the worst offenders." (I don't think that's why most people dread their commutes, Lib Dems. It's the work at the other end.)

For those people who shudder at the thought of clambering onto a train full of TikToks and voice notes in the rush hour, there is one thing you can do: wear your own noise-cancelling headphones and reduce the outside world to a quiet hum. That's a guaranteed way to get some respite, but it isn't always viable. When I'm on public transport with my toddler, I think it's probably best if I can hear her, even if it means also being exposed to someone else's playlist.

Anyway, we should be able to go out in the world without numbing one of our senses. Indeed, I'd like to see fewer people with headphones in. The only thing that drives me up the wall more

than hearing three seconds of a TikTok blare out of an iPhone speaker repeatedly for the entirety of a bus ride is not being able to get someone's attention with a polite "excuse me". When I get on the Tube, I need that row of flip-up seats to safely park the pram. Or I want to slip by someone blocking the aisle in Asda. Or a child has dropped a much-cherished toy and I'm trying to alert a fellow parent in the

“Forget etiquette or minor aural annoyances; I want to be able to communicate with my fellow humans, if only for a moment”

hope of saving them from a future tantrum. But none of these imagined people hears my call, no matter how insistent I get, because they have little white AirPods shoved in their ears.

Forget etiquette or minor aural annoyances; I want to be able to communicate with my fellow humans, if only for a moment, without having to touch them or wave my hand in front of their face to get their attention. People really don't like that.

So rather than a poster campaign begging people to be considerate, I ask that the next time TfL decides to plaster headphone advice across the Tube, the posters include more practical advice. Tell travellers about adapters for headphone jacks, tell them how to set up Bluetooth headphones, even reveal how to enable Transparency Mode on AirPods, so we can hear each other as well as our own tunes.

By all means, if you want to zone out by filling your ears with music, social media, or by catching up on your friend's voice notes, wear headphones when out in public. But pull them out now and then, and hear what you're missing, too.

work@nicolekobie.com

The laptop that won't stop



Barry Collins is a former editor of *PC Pro*. He's thinking of imaginative ways to reallocate his hardware budget. Send inspiration to barry@mediabc.co.uk.
 @bazzacollins

Apple Silicon has completely redefined hardware lifecycles for the better, but how annoying when you're tempted by something new

It was precisely four years ago that I bored you with my company's hard-and-fast hardware lifecycle policy. Namely, "my work laptop gets replaced every three years, once the warranty/care package expires and you enter that dicey period where you're basically crossing fingers and hoping nothing goes wrong".

Reader, I lied. Or, as my company's head of legal affairs (ChatGPT) would describe it: "My statement reflected our general policy intent, though in practice individual replacement cycles have varied based on operational needs and circumstances."

Indeed, three short months after I wrote that column my 2019 MacBook Pro was consigned to the corporate scrapheap – a mere two-and-a-bit years into its lifecycle. Why? Because Apple had released the first MacBook Pro running on Apple Silicon, and the promise of genuine all-day battery life, silent operation and a thinking great improvement in performance over previous Intel chips eroded the resistance of my previously tight-fisted IT director (aka me). A generous trade-in value for that Intel MacBook also helped.

The benefits of breaking my own rule are still being felt to this day; as my M1 MacBook Pro approaches its fourth birthday, I'm struggling to find any reason to replace it.

The truth is, my three-year policy was developed in the days when my daily drivers were Windows laptops. Three years wasn't only the duration of those extended warranties, it was about as long as you could expect to run the hardware before things started creaking. The operating

system was so full of crud it would start to grind, taking a minute or two to reach a usable state each morning. The battery was so knackered, it would only get me through a whole press briefing if I applied the *Two Ronnies* screen brightness setting (four candles). Those laptops went on to give my kids another solid couple of years' service as homework grinders, but they were no longer up to the daily demands of InDesign, Photoshop, Audition and a gazillion open browser tabs.

My M1 MacBook Pro, on the other hand, is still shrugging off anything I throw at it. A wonderful little utility called iStat Menus keeps an eye on my Mac's performance. In the past 28 days, CPU utilisation has never exceeded 55%, memory pressure hasn't blown past 50%, and the fans have barely kicked in despite those summer heatwaves. Granted, I spent much of August on holiday, but there were periods when I was using the Mac intensively for gaming, photo editing and even a little video work. I've also recently added a 34in ultrawide QHD display that runs alongside the Mac's own 16in display, and it hasn't made a blind bit of difference to performance.

Note, this isn't a Honeyball-grade monster spec, either. It's the M1 Pro with only 16GB of memory. I was worried when I bought it that I'd come to regret not paying Apple's handsome premium for 32GB, but it's never been a concern. It's a little slower to boot than it was when new, mainly due to macOS bloat, but it's still a pristine performer. Battery life remains decent too, retaining 83% of the capacity it had when new, according to Apple's own battery health indicator. It's never once run out on me when unchained from the mains.

“Apple has completely rewritten the Media BC Ltd hardware lifecycle policy and – for once – it's a move that's saving the firm money”

Admittedly, the expiry of Apple Care+ is a minor worry for a machine that I rely on for business. Apple offered a short window where I could extend the cover, but the cost was a couple of hundred quid for only an extra year. My head of finance (looks very similar to me) decided that wasn't worth it, that if something catastrophic happened I'd simply replace the machine, because we're already into hardware lifecycle overtime. Anything beyond three years is a bonus.

This MacBook will now keep serving until it can't cope with my software, it becomes unreliable or it's unsupported by macOS. I may be tempting fate harder than booking a return ticket on the Titanic in saying so, but I don't see that happening before its fifth birthday. Apple has completely rewritten the Media BC Ltd hardware lifecycle policy and – for once – it's a move that's saving the firm money, not forcing it to spend more.

The biggest risk of replacement is if my company's chief technology officer (handsome chap, late forties) buckles and decides to buy whatever shiny new laptop Apple launches next; it's very tempting to press that Add to Cart button when you're writing about new technology every day. However, rumours suggest that Apple won't be launching any new MacBook Pros this year, with a major refresh expected in early 2026. The company credit card is probably safe for a while yet. Probably.

 barry@mediabc.co.uk

“As my M1 MacBook Pro approaches its fourth birthday, I'm struggling to find any reason to replace it”

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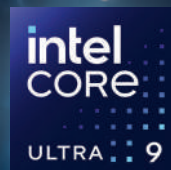
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Where to buy





Readers' comments

Your views and feedback from email and the web

Podcast love

I had to email to tip my hat in the general direction of Mr Grant. After listening to podcasts since the time when podcasts such as TWiT were still in single figures and my knees still worked, Lee's epic outpouring on the dangers of toilet-based doomscrolling was a unique thing of pure beauty. The first time I've ever had to rewind and listen again to part of a podcast not once but twice. Award that man a round of applause and a beer on expenses.

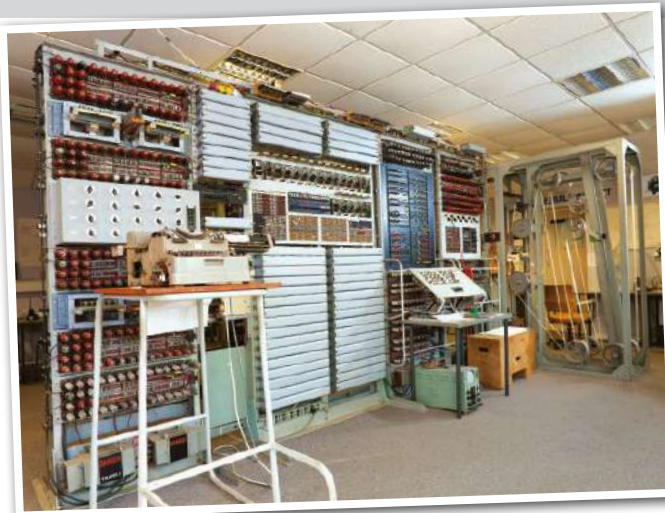
Adam Jackson

Editor-in-chief Tim Danton replies: I couldn't agree more, Adam. Except the bit about buying Lee a beer. For those who wish to listen for themselves, head to episode 758 and jump to around 47mins 45secs.

Fibre monopoly

Further to your correspondent's comment on this topic (see issue 373, p24), when electricity was rolled out in London in the late 19th century one could almost have DC at the back door from one supplier and AC at the front from another. The market sorted this out – though I did come across a legacy 33Hz AC system in the London Underground in the late 1980s.

Even if, as your correspondent suggests, BT/Openreach should have been given the monopoly to install fibre, this still requires suitably regulated third-party rights to be granted over its fibre – ie, a separation of the "pipe" ownership/operation and the utility service it provides – as there is in electricity.



ABOVE The Colossus replica at The National Museum of Computing is well worth a visit

I live in a rural location and an independent broadband provider has recently laid fibre in my road. In investigating whether to move to it from my copper service, I asked it what protection I had if, at the end of the initial two-year contract, its prices were not competitive. They replied that they didn't let others use their fibre and there would always be deals available – in other words, trust us.

It also advised that their terms of contract required the granting of a perpetual wayleave right that would bind successor owners. So, once laid, I wouldn't be able to remove its fibre or, indeed, its connection equipment in my premises. To which I replied that, if other providers did eventually come, I could slowly collect multiple fibres to my premises (at least until the duct filled up). This appears to be a broken regulatory model.

I elected to stay with the copper until some sense prevails.

Ian Smith

Colossal question

The article on the Colossus (see issue 373, p34) was very interesting. It reminded me of a question that arose some time ago from a visit to Bletchley Park; I met Tony Sale [the motivational force behind the Colossus replica at the National Museum of Computing] who told me that it was getting difficult to maintain the working version of Colossus that they had because of getting the valves, EF37As.

That valve is a low noise audio pentode, a rather odd choice for an application in a binary circuit (either "on" or "off"). Odd because this valve's dynamic characteristics – slope, impedance and so on – are identical to the EF36, a rather more common valve which should still be available from old stock vendors. I surmise that the EF37A would have been manufactured to a tighter spec than the EF36, hence could be more reliable in such a critical application; any comments, anybody?

Sean Davies

Visit Colossus!

What an excellent article about the Colossus by Tim Danton. Of no interest to anyone else, but about 15 years ago my wife and I visited Bletchley with a couple of friends. From her gardening side my wife had become quite friendly with Mavis Batey, who was one of the leading code breakers, recruited by Dilly Knox. She broke the Italian Enigma and the Abwehr Enigma codes. The

Star letter

Whose fault?

It is in many ways remarkable how reliable computers are these days, and I have not had a faulty computer since the early 1990s. However, earlier this year I purchased a Lenovo tablet, which has a major flaw in that whenever data is backed up onto a USB stick using Robocopy, the USB stick becomes corrupted.

Using Windows EventViewer there appears to be a fault in the power supply to the USB ports, but Lenovo has been unable

to rectify the problem despite replacing the motherboard twice. Lenovo now seems to feel that it has done all that it can and I am left with a tablet that is not fit for purpose as it doesn't back up data to a USB stick safely.

Whether this is a fault with the hardware (perhaps a glitchy power supply) or with the installed software (although the error appears even after a complete re-install of Windows) is unclear, but the issue does raise the question of a manufacturer's responsibility to ensure that a computer is fully functional.

Or perhaps I need to accept the cost of an occasional faulty computer as being around

£60/year over 30 years, so long as I don't get another dud computer before 2055!

Tom Britton

Contributing editor Lee Grant replies: The good news is that the Consumer Rights Act (2015) is on your side. If the tablet began to hiccup within six months of purchase, the retailer has to prove the fault wasn't present when you took it out of the box. The retailer has a right to repair or replace and, if that fails, you can ask for a refund. As Lenovo has failed to get it working after two bites of the cherry, I suspect your retailer will roll over quickly.



This month's star letter writer wins a Cherry Stream Desktop Comfort keyboard and mouse wireless set, worth £80. For a chance to win, email letters@pcpro.co.uk

Readers' poll

Apple, Google and Samsung have all released glitzy new phones recently, but what features do you really care about?



husband of the couple we went with had Blinker Hall as his godfather.

We were overheard by one of the senior resident guides, who then took us all over the place. The Colossus was a magnificent beast, but the two other things that struck me were, first, how appalling the working conditions must have been – drab rooms with hard tables and chairs and pencils and paper, and that was it. The other thing that amazed me was the staggering quality of the engineering. Every little part in the museum there is utterly beautifully made. Without modern tech and equipment, it is truly amazing. Everyone would enjoy a visit.

John Wallinger

Editor-in-chief Tim Danton replies: Thanks, Sean and John, for your kind words. I will leave the valve questions to more knowledgeable people, but I do wholeheartedly agree that the replica at the National Museum of Computing, on the same grounds as Bletchley Park, is definitely worth a visit. It also holds an amazing collection of working computers from the 1980s and even earlier.

Bye-bye Flyby

Lee Grant mentioned in his article about the end of Windows 10 (see issue 372, p26) software called Flyby11, now superseded by Flyoobe, as a way of installing Windows 11 on older computers that fail the normal hardware check. I have now done this and it works brilliantly. My question is: why am I just hearing about this? You have done several articles about the end of Windows 10 and I don't recall seeing this software mentioned. I help a lot of elderly people with their IT, including several who have bought new computers because the old one failed the Windows 11 check. If I had known about this software I could have saved them a lot of pain and expense.

David Wright

Contributing editor Lee Grant replies: Microsoft continues to turn a blind eye to running 11 on unsupported hardware. The consensus is that at some point after 14 October, updates will stop and the major updates (25H2, etc) will require an inconvenient wipe and reset. Flyby11 gets us over the hurdles at the moment, but what happens in six months' time is anyone's guess. For this reason, it would be negligent of PC Pro to suggest that Flyby11 was a long-term solution.

Can a message be any clearer? Across X and Facebook, our readers are shouting at Apple, Google, Samsung et al that battery life is the most important feature to them – from our shortlist, at least. "Battery life, battery life and battery life," as Mike Gannon put it. "Something to get through 5-7 hours of walking using GPS without having to cart the second battery with me," agreed Ro Barltrop.

But perhaps we should have included size in our poll, as that was another theme. Along with Ro wanting a "pocket-sized phone", John Wright asked: "Is it small enough to fit in my running belt? That's almost all I care about if the battery lasts until 5pm and it can take a reasonably decent photo. I have the iPhone 13 mini and it's perfect for this. Runners don't want big phones!"

Several people mentioned repairability, too. "Battery, folding and repairability are all about equal," said Michael Tott. "If Fairphone did a foldable that would be ideal for me." Aside from mourning the loss of SD card expansion, Geoff Miles had one specific request: "Replaceable

battery would be nice but then pigs might fly!" On similar lines, @mrmiley on X (Miles Davis) wrote that he was "more concerned that it has a memory card slot and a headphone jack to be honest. I carry a lot of music on my phone."

Better camera quality was another recurring request. "I bought the iPhone 16 Pro Max solely because it was a significant upgrade in camera over my iPhone 14," said Paul Carter. "It's also the incentive to get rid of my remaining traditional cameras. I simply never use them."

"To cover a holiday I was planning I considered a new camera but realised (a) I will always have my phone with me; (b) will it just join the basket of other high-quality cameras after the holiday?" wrote @hobson1999 (Crusoe) on X. "So I bought a smartphone with a good camera."

So cameras and battery life: we get it. But there is the point that you don't know what you really want until you try it. "I've lost track of the number of innovations I've dismissed before shortly after acquiring and regularly using [them]," wrote @artbookreviews.

⚡ Battery, battery, camera ⚡

Stuart Hughes

⚡ I want a small (not ooh shiny) phone for my small lady's hands. But, I've decided it's time to put my money where my mouth is and limit my damage to the planet with a Fairphone. ⚡ **Tanya Taylor**

⚡ Phones become paperweights without their power. ⚡ **Phil Wane**

⚡ None of the above... Doing what I want, the way I want to do it, using the tools I want to do it with. ⚡ **John Moore**

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WIPE ALL YOUR DEVICES

Don't discard your devices without securely erasing their data first. **Barry Collins** reveals how to wipe a wide range of tech

Given that Windows 10 is nearing the end, many people will be preparing to retire a PC over the next few months. But before you pull the plug on that PC for the last time, you need to ensure you've erased any sensitive data – and that requires more effort than simply running through the Reset procedure. Of course, it's not only Windows 10 PCs that are being decommissioned. So, here we're going to run you through how to ensure all the devices we use regularly are properly wiped before we send them on to their next destination – whether that be a friend or relative, a buyer or even straight to the recycling centre. You can't be too careful, even with a device that's destined for the crusher.



WINDOWS PCs

If you're disposing of a Windows 10/11 PC, you'll certainly want to clear off all your personal files first. And you might well be tempted by the Reset PC facility, which offers you the option to "remove everything" including "all of your personal files, apps and settings".

However, only when you delve into the Microsoft support pages for the Reset PC feature (tinyurl.com/374resetpc) does a rather ominous warning appear: "The data erasure functionality is targeted at consumers and does not meet government and industry data erasure standards," it warns.

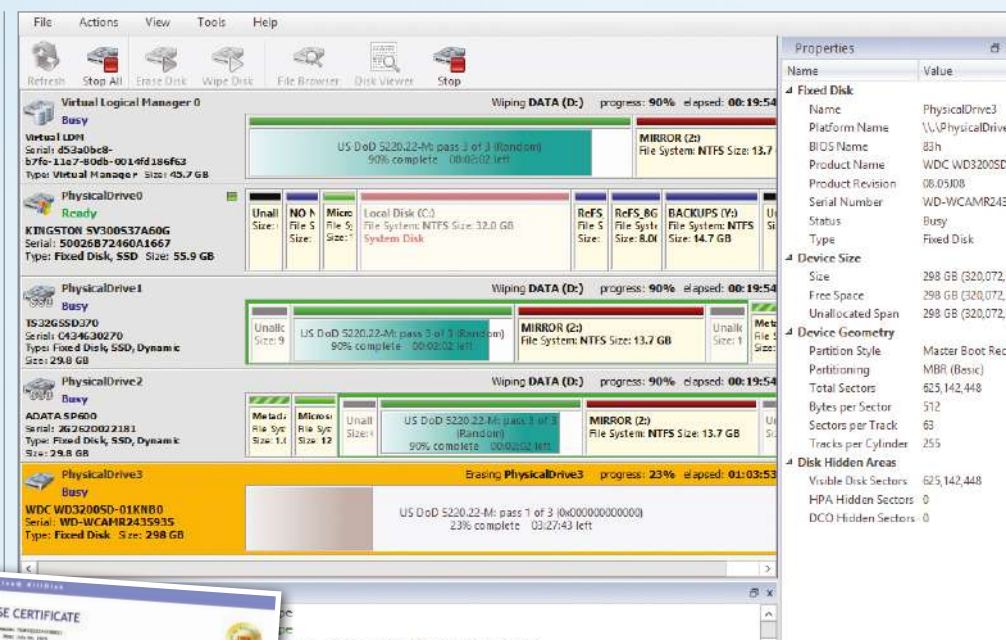
Even more unhelpfully, it doesn't explain precisely what it does when "removing everything". Does it just delete the files? Does it write over them? We're really none the wiser. That is until you click two screens further through the Reset PC wizard and select the Change Settings link. Now you'll find an option to Clean Data, which reveals the default is to simply remove your files.

Microsoft still doesn't really explain what Clean Data actually does, but the help page recommends that you use this option if you're "planning to donate, recycle, or sell your PC".

"This might take some time," it adds, "but it makes it harder for other people to recover files you've removed."

Again, not particularly revealing. Certainly less helpful than this video from IT professional Jason Bagnell (tinyurl.com/374youtube), which shows him resetting a PC with the "Clean Data" option ticked and then trying to recover files from that PC using the well-known Recuva utility. It can't find anything other than Windows operating system files. For good measure, he uses a Hex editor to examine the raw data on the drive and discovers it was written over with random data.

So, it seems Windows does a reasonably good job of overwriting personal data, but if you want to be sure, it's time to



ABOVE KillDisk is a great third-party utility that comes recommended by PC Pro's Lee Grant

reach for third-party utilities. Our PC repair guru, Lee Grant, has been a long-term user of KillDisk (killdisk.com) when he's nuking customers' hard disks and SSDs.

KillDisk does have a free version, but if you want it to overwrite the contents of a drive with anything more than a single pass of zeros, you'll need to pay \$49.95 (around £37) for the personal licence or \$69.95 (£51) if you're using it for business. This unlocks – among other features – a variety of erasure standards, including the British HMG ISS Enhanced, which makes three passes to ensure no trace of data is left behind. The software also lets you print a label to attach the drive, and a certificate to give to a new owner, to show that the drive has been fully erased and to which standard.

You can't erase your system boot disk from the Windows application. Instead, you'll need to use the software to create a bootable USB drive with a portable version of the software on. This will wipe out the Windows installation too, so if you're planning on reselling the PC or giving it to someone else, you might want to prepare a second USB drive to install Windows 10/11 from.

When it comes to wiping the drive, you're going to need to boot into the KillDisk USB, so make sure you know which key gets you into the UEFI boot menu for your PC (a Google should suffice). Then, once the wipe is complete, you can reinstall Windows from your second USB stick.

If you own external SSDs for backing up your data that you want to securely wipe, it's also worth checking out the utilities provided by the manufacturers. Seagate's SeaTools 5 (tinyurl.com/374seagate) includes various options to wipe the drive, including "overwrite sanitize". This allows you to pick from various algorithms that overwrite the data to different government standards.

Samsung's Magician app (tinyurl.com/374magician) offers a similar facility, using a firmware command to regenerate the internal encryption key, rendering any data previously stored on the drive unreadable.

Talking of which, if your Windows machine had BitLocker encryption turned on in the first place, it seems your best bet is to create a Windows recovery media USB drive, boot from that and use the Advanced Setup option to delete the partition protected by BitLocker. Then create a new partition and install the OS into that. Even if some of the old BitLocker data isn't written over, it's fully encrypted, so there's no danger of it spilling any secrets.

RIGHT You can use a USB drive to delete a BitLocker-protected partition



APPLE MACS

Securely wiping a Mac is much easier than it is with Windows provided you own a relatively recent machine. All Apple Silicon-based Macs have the FileVault encryption switched on by default. Even Intel-based Macs with a T2 security chip have FileVault, although it wasn't switched on by default on these machines.

If you do have a FileVault-enabled machine, securely wiping your machine is simply a case of going to Settings | General | Transfer or Reset | Erase All Content and Settings. This wipes out the encryption keys, which means nothing is recoverable.

This is because on modern Macs, Apple creates two disk volumes: a System volume that contains the operating system and a Data volume that contains all the user files. The Erase All Content and Settings function basically wipes out that Data volume and creates a new one with fresh encryption keys, ensuring the system is effectively restored to factory settings. It doesn't take long, either.

If you have an older Mac that doesn't have FileVault encryption turned on,



ABOVE All Apple Silicon-based Macs have the FileVault encryption enabled by default

the process is more laboured. First you must sign out of all Apple services on the Mac: iTunes, iCloud and iMessage. You then have to restart the Mac and boot into macOS Recovery by holding

down the power button. From there you should be able to access the Erase feature from within Disk Utility. This will wipe the operating system with it, so you'll then need to boot back into Recovery and reinstall macOS from the menu screen.

It's not clear how secure the Erase facility in Disk Utility is, so to be sure you might want to log in to the freshly re-installed operating system and use something like KillDisk to write over the unused space again, just to be doubly sure. KillDisk can also be used to deal with any external drives you had attached to the Mac.



RIGHT Modern Macs have two disk volumes

CHROMEBOOKS

Chromebooks don't normally store a wealth of personal files, but data that you won't want falling into the wrong hands such as browsing history and passwords are stored on the device.

The good news is all data on a Chromebook is encrypted by default, with each user having their own encrypted store. That means when you enact the option to reset or "powerwash" the Chromebook, the user accounts are deleted and that severs the link to the encrypted content. Although it's still residing on the disk, it shouldn't be accessible in any practical sense.

If you want to be doubly sure, you can manually overwrite data in Developer Mode, but bear in mind



ABOVE You can reinstall ChromeOS from a USB drive if you want to pass on your Chromebook

that this will wipe out everything, including the operating system. To enter Developer Mode (which in itself powerwashes the device), hold Escape+Refresh+Power, then

press Ctrl+D when prompted. After going through a few confirmation stages, you should be able to open a terminal by pressing Ctrl+Alt+T. Then type "shell" to get access to the full Linux shell.

Use the command "lsblk" to confirm the disk name, then type:

sudo shred -v -n 3 /dev/mmcbkl0

This overwrites the disk with random data three times. If your disk isn't called "mmcbkl0", replace that with the correct name.

You'll need to reinstall ChromeOS from a USB drive using the Chromebook Recovery Utility extension in Chrome if you want a working Chromebook to pass on or sell.



MEMORY CARDS

Memory cards are highly likely to contain photos or videos that you don't want others to see. They might also contain sensitive data, if you've used one to boot a Raspberry Pi, for example.

While it's a doddle to destroy a memory card – hell, we've destroyed dozens without even trying – it's more environmentally friendly to wipe them clean and pass them on. Even if you are intent on destroying the card, wiping it first will make sure nothing is retrievable from the fragments.

The good news is utilities such as KillDisk (mentioned in the Windows and Mac sections on the previous

pages) will treat SD cards just like any other drive, so you can use that to write over the card's memory and ensure nothing is retrievable.

That said, when we used KillDisk to erase an SD card, it needed to be reinitialised the next time we put the card in a computer. That's not ideal, as it may lead less tech-savvy users to discard it as defunct. Step forward the SD Association, which offers a free formatter for Windows and Mac (tinyurl.com/374sdcard). It claims that regular formatting tools "may not be optimised for SD/SDHC/SDXC/SDUC cards and it may result in lower performance".

The formatter includes an option to "overwrite the user data area completely", according to the utility's FAQ page, although it doesn't say how many times, presumably once. However, that should be enough for all but the most sensitive of data.

LEFT The SD Association provides a free formatter



iPADS & iPHONES

The good news when it comes to iPads and iPhones is that they're protected in precisely the same fashion as modern-day Macs. The system volume containing the operating system and the user data volume are kept apart, and when you choose the option to erase all data on the device, it burns the encryption keys and resets the user volume, meaning there's no practical way for the next person who gets their hands on your device to get their hands on your data.

To wipe an iPad or iPhone, open the Settings app, select General | Transfer or Reset iPad/iPhone and select Erase All Content and Settings to go through the process.

RIGHT It's easy to wipe an iPhone or an iPad



MORE DEVICES THAT ARE WORTH A WIPE

If you're passing on any of the following devices, returning them to the vendor or even just sending them for recycling, it's well worth performing a factory reset first. If you're passing them on, it might prevent the recipient running into setup problems. If not, you've done the best you can to ensure that no sensitive data leaks.

WI-FI ROUTERS

It's become almost standard for ISPs to demand routers back from you if you switch provider. These obviously store details such as SSIDs and passwords, and although you'd be ill-advised to reuse these for a new router, many people do out of sheer convenience. Most routers have a factory reset option that allow you to clear the device's memory.

Some, such as the Virgin Media Hubs, even have a physical reset button on the back, which you can use to clear the settings.



SMART SPEAKERS

Although smart speakers store very little on the device and shouldn't be able to go online if they're not connected to your home network, it's worth logging out of such devices before you pass them on – especially if you're expecting them to be reused. For Amazon Echo devices, you can do this by opening the Alexa app, choosing Settings | Device Settings then selecting the relevant device. Now hit the settings cog for that device in the top-right corner and scroll down to the bottom of the page, where you can deregister the device from your account.

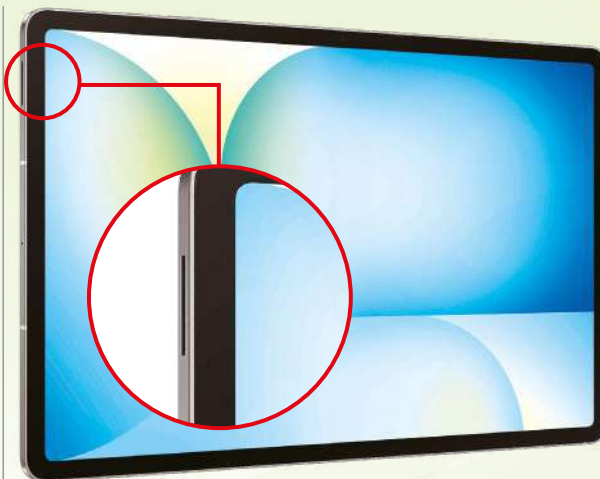


ANDROID DEVICES

Modern Android phones and tablets are very similar to iPads/iPhones in that they have encryption turned on by default. If you follow the procedures to factory-reset your device (these vary slightly from handset to handset), there shouldn't be any practical way for a new owner to retrieve your data. This encryption system has been in place since Android 10, released back in 2019, so very few devices in circulation today won't be protected.

That said, there are a couple of extra considerations for Android handsets. Unlike Apple devices, some Android phones/tablets allow you to pop in memory cards to supplement the built-in storage. You might want to ensure they're properly wiped by using the utilities mentioned in the memory cards section opposite.

If you want to be doubly, triply sure that the data on the phone's internal storage has been zonked, you can install the free iShredder app from the Play Store. This includes an option to overwrite any free space on the phone with junk data, although like KillDisk for Windows/Mac, you have to pay for the premium version if you want to access the "military-



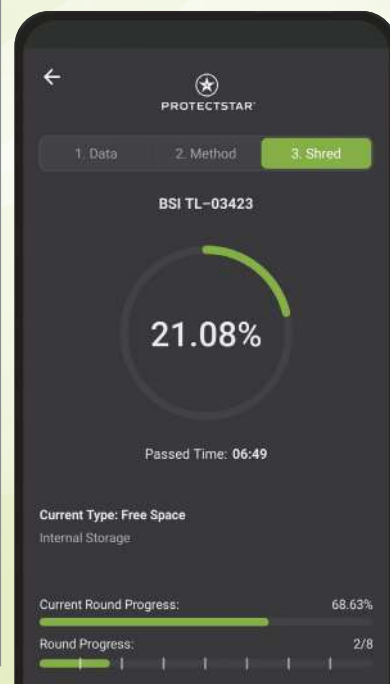
ABOVE Wipe any memory cards you've used to expand the storage

grade" options where it takes multiple passes. If you want to run this app, it's best to factory-reset the phone first, log in again (ignoring all options to restore apps/data from the cloud) and then install and run the iShredder app to fill the free space with junk data. You should then factory-reset the phone once more.

If you regularly handle sensitive data on your phone, it might be worth installing iShredder for day-to-day use. It can be used to erase and write over individual files, although again

RIGHT iShredder is a free app that can overwrite data

– if you want it to tackle specific folders or data from apps such as WhatsApp and Telegram – you'll have to upgrade to the premium version. That costs £1.39 per month, although there is a "lifetime" licence on offer for £28.



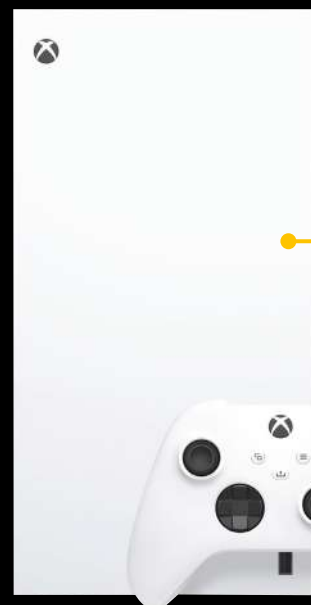
PRINTERS

Again, printers will store Wi-Fi connection details to help them join your network. Although the risk of anyone hacking into a printer to retrieve such details is remote, you might as well flush them out before you dispose of the device by using the factory reset, not least because it might trigger the networking wizard for any new owner.



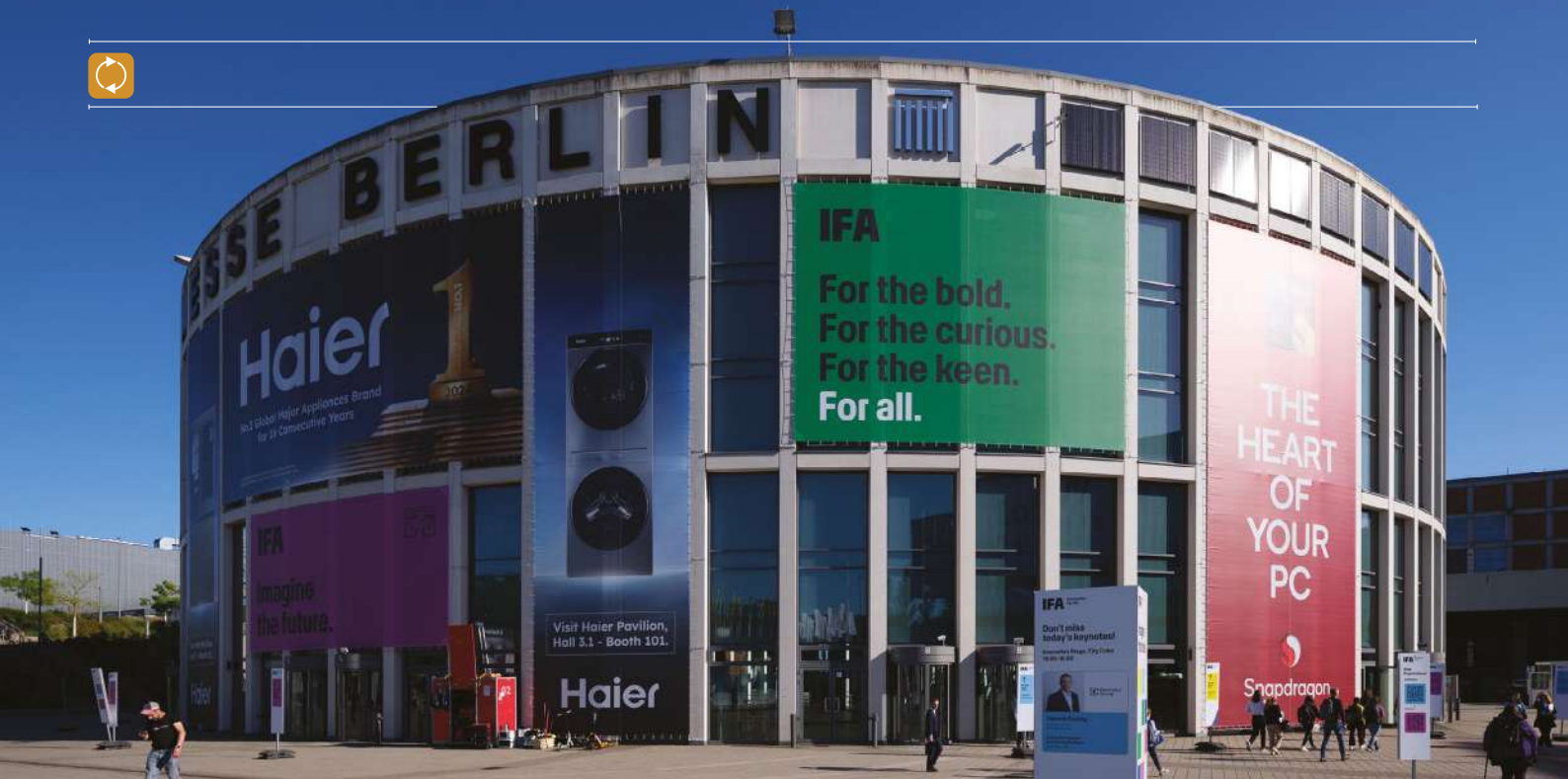
GAMES CONSOLES

Games consoles encourage you to leave payment details stored in them to make it easier to purchase games, and they will often also store details for various accounts, such as Game Pass, Netflix and Spotify. Log out of accounts and factory-reset the console before you even think of passing it on or discarding it.



SMART TVs

TVs are now a hive of personal data. How many times have you rented an Airbnb to find someone else's Netflix account or YouTube credentials stored in the TV, for example? A factory reset will avoid any chance of someone being able to hijack your accounts or even make purchases from details stored in the device.



BEST OF IFA 2025

WE SHARE OUR 29 FAVOURITE PRODUCTS LAUNCHED AT THE "WORLD'S BIGGEST TECH EVENT" IN BERLIN

CONTRIBUTORS Tim Danton with contributions from Erin Bashford, Cat Ellis, Jason England, Jon Honeyball, Cale Hunt, Tony Polanco

Every September the great and the good of the technological world descend upon Berlin for a riot of technology launches. Some live on in history, such as the first VCR in 1971 and the debut of the compact disc a decade later. Most have their moment in the sun before being cast into the eternal shade of history. And this year – well, we have a mix.

Perhaps the biggest news was the arrival of a Panther Lake laptop, as we cover on p35, while ThinkPad purists will likely go as white as the X9 Aura Edition's finish on seeing Lenovo move away from its purist black roots. Acer also claimed headlines for its sub-1kg Acer Swift 16 Air AI. We provide our first take of all IFA's new laptops over the page.

This is also proving to be a bumper year for mini PCs, and Acer again provided the debut for Nvidia's Grace Blackwell superchip in such a form factor. Although in truth these are workstations rather than PCs as we typically think of them, begging the question of whether you need ever go full tower size again.

There was room for fun this year, too. Our editor played tennis with an AI robot (he refuses to say who won), we tried on the latest smartglasses and went retro with a 1980s-style boombox updated for the modern era. And even Jon Honeyball was impressed by Samsung's latest transparent OLED technology.

MINI PCs & WORKSTATIONS

ACER VERITON GN100

PRICE From €3,999 inc VAT from acer.com

AVAILABLE Q1 2026

For now, this is as close as you're going to get to an AI supercomputer in your pocket. That's because it's based on Nvidia's ever-so-humbly named GB10 Superchip, which promises 1,000 TOPS for AI inference, around 31 TFLOPS of FP32 performance and 1 PFLOP performance at FP4 precision. Can it play *Doom*? Probably, and at around a million frames per second. But more importantly the Acer Veriton GN100 allows scientists, researchers and well-heeled students the opportunity to develop and run their own inference models on their own hardware. You can even connect two GN100 computers together to run in parallel, bringing AI models with up to 405 billion parameters into play. It runs on Nvidia's Linux-based OS, DGX, and comes pre-installed with its AI software stack to make it as developer-friendly as possible. Once you're ready to deploy to the cloud, it should be simple to do so (Nvidia promises) using DGX Cloud or similar. TIM DANTON



ACER CHROMEBOX MINI CXM2

PRICE From €199 inc VAT (€299 for Enterprise version) from acer.com

AVAILABLE Now

Tight on space? Hate fan noise? Despire spending wads of cash on new computers? Well you should rub your hands with glee at the thought of Acer's new budget Chromebox, which is less powerful than the CXI6 (see right) but more than capable of lightweight tasks thanks to Intel's four-core Processor N150; higher-spec models are available. It's well connected thanks to Wi-Fi 6E, 1GbE wired networking and a generous sprinkling of HDMI and USB ports, all packed into a slim black box that's very much designed for tucking behind a monitor and out of view. TIM DANTON



ACER CHROMEBOX CXI6

PRICE From €299 inc VAT (€399 for Enterprise version) from acer.com

AVAILABLE December 2025

It's a shame the CXI6 wasn't released in time for our mini PCs group test (see p78), for this tiny box packs one of Intel's highly capable Core 100U processors – right up to the Core 7 150U. This lifts it well above the CXM2 to the left, as does a 2.5GbE port to accompany Wi-Fi 6E. A fast PCIe M.2 SSD helps speed things along, too. You can even connect four monitors thanks to two HDMI outputs, a DisplayPort and a USB-C port. It's still compact enough to easily fit behind a monitor, while a Chrome Enterprise Upgrade adds £xx to the price but also brings extra support and useful management features. TIM DANTON



GEEKOM A9 MEGA

PRICE \$1,899 from kickstarter.com

AVAILABLE Q1 2026

The A9 Mega took pride of place on Geekom's stand at IFA, as well it should. Like the HPE Z2 mini workstation (see p60), but at a much lower price, it packs an AMD Ryzen AI Max+ 395 CPU and 128GB of RAM, opening up the possibility of running huge LLMs locally. Or simply playing games, with Geekom luring prospective buyers with the prospect of "seamlessly" running *Cyberpunk 2077*, *Eden Ring* and *GTA V* with ray tracing. Judging from the heat output I felt from the rear fans this thing will eat watts for breakfast, but who cares when it's in a box that measures 171 x 171 x 71mm? And there's still room for up to 8TB of storage. Look out for the Kickstarter campaign where you can back it for \$1,899, but we don't have a firm delivery date yet. TIM DANTON





LAPTOPS

ACER CHROMEBOOK ENTERPRISE PLUS SPIN 514

PRICE From €879 inc VAT (€699 for non-Enterprise version) from acer.com
AVAILABLE October 2025

Walking into the large hall containing every one of Acer's 25 products announced at IFA, I had no intention of stopping at the Chromebooks section. But there's something about the Plus Spin 14 that lifts it apart from the chasing pack, whether it's the chrome edges on the lid or the shiny metal hinges – paint them gold and Donald Trump would be a very happy customer. Here, though, Acer has everyday consumers in mind for the plain Plus Spin 14 edition, while it hopes to lure businesses and education buyers with the Enterprise version (which comes with extra support and manageability). Both feature local AI thanks to the MediaTek Kompanio Ultra 910 chip, while a high-quality 14in touch panel, up to 16GB of RAM and 256GB of storage, and a claimed 17-hour battery life round out its attractions. **TIM DANTON**



ACER SWIFT 16 AIR AI

PRICE From €899 inc VAT from acer.com
AVAILABLE Now

Hmm. Or, as I might type that on the Acer Swift 16 Air AI keyboard, hmfpxphy, for its keys are so close together that typos are surely inevitable. But this is only my view. You may love Acer's "reimagined" keyboard, with its lattice arrangement and incredibly striking design. Nor should I ignore the incredible feat of fitting in AMD's powerful Ryzen AI 300 chips, up to 32GB RAM, up to 1TB of storage and a glorious 16in AMOLED panel into a chassis that weighs under 1kg. Acer reckons you can get up to 13 hours of battery life, too, but in real-world use I suspect that will drop to single figures. Let's wait and see what I find after a full review – if Acer dares send one to me. **TIM DANTON**



LENOVO VERTIFLEX CONCEPT

Lenovo loves to unveil concept devices at the big trade shows, and most of them come to nothing – one exception being the ThinkBook Rollable we review on p48. At IFA this year, the idea once again involved the screen but this time it rotates in situ by 90 degrees. It's a simple mechanism, merely involving you grabbing the panel by the corners and rotating it; the backplate of the lid stays in place. At this point you may be asking yourself "why?", which is what I asked of Tom Butler, VP of Lenovo's commercial portfolio. "The number one posture of the X1 Fold [its foldable PC] has been portrait mode because of the productivity gain," he told me. "If you look at a coder, they're going to have a monitor orientated landscape and a monitor orientated portrait." Noticing that the laptop I was playing with appeared to be very close to production quality, I asked if perhaps this launch might be happening sooner rather than later. I only got a laugh in response, and a "we still have to solve some things" (such as specks of dust getting in the way), but I wouldn't be at all shocked if it lands in some form next year. **TIM DANTON**





ACER TRAVELMATE X4 14 AI

PRICE From €899 inc VAT from acer.com

AVAILABLE Now

Okay, I admit it: compared to the Panther Lake-packing Acer Swift 16 AI or sub-1kg Acer Swift 16 Air AI the TravelMate X4 14 AI (TMX414-51) is dull. An instant conversation-stopper. But it's also an affordable route into AI/Copilot+ laptops for small to medium-sized businesses, with the promise of "enterprise-grade security" along with Intel's familiar Lunar Lake Core Ultra 200V chips. It weighs a travel-friendly 1.3kg and is 15.9mm thin, while the 14in screen is available in IPS and OLED versions. And it packs all the usual ports, including a pair of Thunderbolt 4 connectors. **TIM DANTON**



INTEL GIVES PANTHER LAKE DEBUT WITH ACER SWIFT 16 AI

I'm not suggesting that Intel is betting the farm on Panther Lake, but the combine harvester and outhouse are definitely up for grabs. This is its successor to Lunar Lake, aiming to deliver multicore speed, superb battery life and top-notch AI skills in one package, and Jim Johnson, head of Intel's Client Computing Group, joined Acer CEO Jason Chen during his IFA keynote to announce that the Acer Swift 16 AI would be among the first to debut the chip.

We've already seen a Core Ultra 200V version of this super-slim 16in laptop, and it weighs **x.xkg** while packing a top-quality OLED panel and offering around 13 hours of battery life. Panther Lake will be the third generation of Core Ultra chips, and promises even greater AI chops thanks to more powerful graphics and the fifth generation of Intel's NPU.

"It's a beautiful machine and I can't wait until we launch this product together," said Johnson. "It's going to become the playground for unbelievable creativity and creation using AI tools and new hardware."

In particular, Intel is pushing its own AI Assistant builder. These are ChatGPT-like bots that run locally on your device, so rather than uploading personal data to the cloud you keep everything on one machine. Johnson also pushed the idea of AI agents. "So you can use your local data and then go out and get things done," he said. "For example, if you and I are travelling, we can use our local data from our calendar and subject matter, but then use APIs to book our travel, book our rooms, book our hotels." **TIM DANTON**



LENOVO THINKPAD P16 GEN 3

PRICE €2,899 inc VAT from lenovo.com • AVAILABLE October 2025

If you need creative power on the go then Lenovo is hoping its redesigned ThinkPad P16 might just catch your eye. This third generation is both lighter and slimmer than its predecessor, measuring a trim 20.9mm at the front and a rather beefy 29.8mm at the rear. That height, and the 2.5kg weight, are both more than justified by what Lenovo packs within: Intel's powerful Core Ultra 200 HX series processors with up to 24 cores, while memory peaks at 192GB and storage at 12TB (via a trio of 4TB drives). But it's Nvidia's RTX Pro 5000 Blackwell GPUs that will surely set pulses racing, bringing complex 3D rendering tasks into the fold – as shown in the image above, although quite why he's typing sideways is another matter. **TIM DANTON**

LENOVO SMARTMOTION CONCEPT

I use a laptop stand at home and the office, so I was keen to give this concept a try. It uses motors to move up, down and side to side.

The system integrates with a laptop camera, microphone and speakers to deliver auto-facial tracking and voice control. You can use gesture control, too. The stand rotates between 120 to 180 degrees, so it has a limit, but it can be handy to have a device follow you, particularly during virtual classes or presentations where you want to show something to whoever you're engaging with while staying in the frame.

TONY POLANCO



LENOVO THINKPAD X9 AURA EDITION GLACIER WHITE

PRICE 14in €1,619 inc VAT from lenovo.com

AVAILABILITY October 2025

No need to string this one out: Lenovo has released its first ever white ThinkPad. As I mentioned in my original review of the X9 Aura Edition (see issue 368, p50), this 1.3kg, 14in laptop is aimed at younger audiences who may otherwise lean towards MacBooks and have no use for a TrackPoint. It's a sleek and fast machine up to all the usual ThinkPad standards, bar for its matte white finish – which I can confirm looks great and proved resistant to fingerprints. Lenovo is also releasing a white version of the 15in version of the X9, but both, I was told, will be "very short" production runs, so get in there quick if it sounds white up your street. **TIM DANTON**





PHONES & TABLETS



MOTOROLA G06 POWER

PRICE £90 inc VAT

AVAILABILITY To be confirmed

While Motorola gained many headlines for its Edge 60 Neo, also announced at IFA, I was more drawn to the ultra-affordable G06 Power. That's because it includes a whopping 7,000mAh battery, enough to get you through two days at a push. What's more, in the hand this doesn't feel like a cheap phone at all. Sure, this becomes clearer when you peer at the 6.9in panel with its 720 x 1,640 pixels, and it's no speed monster with a five-year-old MediaTek Helio G81 Ultra processor inside, but it runs Android 15 perfectly well and has its place in less demanding pockets. **TIM DANTON**

TCL NXTPAPER 60 ULTRA

PRICE From £449 inc VAT from tcl.com/uk

AVAILABILITY Now

I'm already a fan of TCL's Nxtpaper technology, which shifts from matte colour to a Kindle-like black and white at the press of a button. This fourth iteration appears to be the best yet, with numerous promises about eye care to avoid screen fatigue. The 60 Ultra's 7.2in screen makes this a natural choice as a Kindle alternative, and while the phone is inevitably big I still slipped it into my pocket easily enough; you won't look stupid using it to make a call. I'll wait to give my verdict on the new zoom camera, the promised AI features and the speed of the MediaTek Dimensity 7400 processor, but all the signs are very promising. **TIM DANTON**



SAMSUNG GALAXY TAB S11 ULTRA

PRICE 256GB, £1,199 inc VAT from samsung.com

AVAILABILITY Now

Samsung announced the 11in Galaxy Tab S11 and 14.6in S11 Ultra at IFA, and they were the best tablets I got my hands on at the show by a distance. The secret sauce isn't about any individual thing but the sum of all its parts. Its Dynamic AMOLED 2x screen is absolutely gorgeous, particularly across the 14.6in diagonal of the S11 Ultra, and when paired with the new Dimensity 9400 Plus chipset and up to 16GB RAM it's hard to think of a task that won't become a pleasure on this 700g machine. I even enjoyed using the redesigned S Pen with its hexagonal barrel and solid cone tip. You also benefit from Samsung's Galaxy AI features and upgrades to Samsung's DeX desktop mode: attach a monitor and you can now expand your workspace rather than just mirror it. **JASON ENGLAND**



SAMSUNG GALAXY S25 FE

PRICE 128GB, £649 inc VAT

from samsung.com

AVAILABILITY Now

We all know the name of the game for the Fan Edition (FE) lineage of Samsung phones: a hint of the flagship experience at a mid-range price. For £649, you get a gorgeous 6.7in AMOLED display, a decently sized 4,900mAh battery and almost all of Samsung's AI and software smarts in One UI 8. It also looks the part, with an Armor Aluminium frame. Put simply, this is a strong mid-range revamp that brings the key things we love about the original S25 at a lower price. The sacrifice is all-out speed, with Samsung's mid-range Exynos chip inside, but you still get a full seven years of updates. **JASON ENGLAND**

TCL NXTPAPER 5G JUNIOR

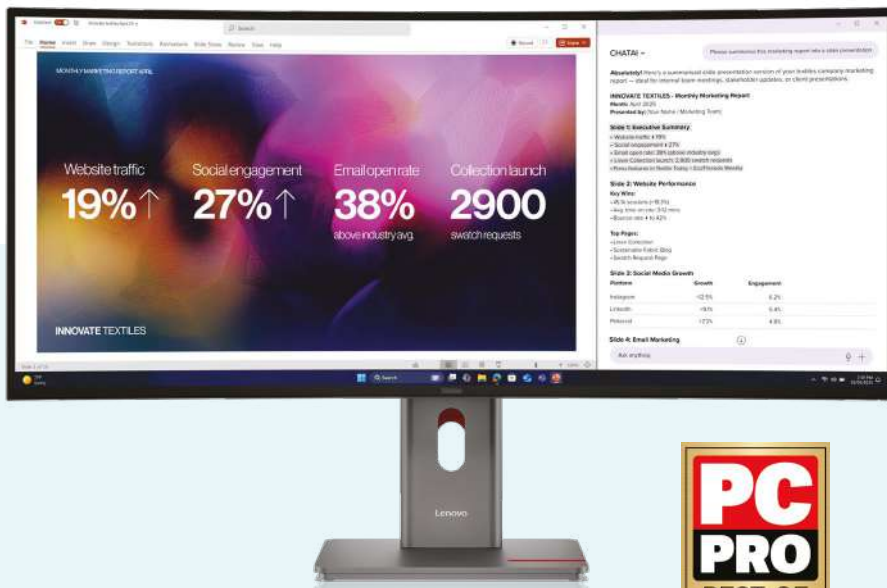
PRICE £249 inc VAT from tcl.com/uk

AVAILABILITY October 2025

TCL describes this as a "dedicated smartphone for teenagers". As its name reveals, it uses TCL's clever Nxtpaper technology, and here the idea is that youngsters can ignore distractions using a "Digital Detox Mode" that switches to mono and kills off annoyances such as messenger apps. Google's Family Link adds safety measures such as content filtering and real-time location tracking, along with limits on screen time and app control. **TIM DANTON**



MONITORS



LENOVO THINKVISION P40WD-40

PRICE €1,4999 inc VAT from lenovo.com
AVAILABLE November 2025

If a 32in monitor simply doesn't give you enough space, then let this 40in widescreen offering fulfil your dreams. With a phenomenally sharp 5,120 x 2,160 resolution it's very nearly equivalent to having two 27in 4K screens side by side, with a soft 2500R curvature so you don't need to slide your chair along to see detail on the edges. To help control power consumption Lenovo provides an adaptive refresh rate, from 24Hz to 120Hz, which did make a difference while I watched on, although don't imagine that will claw back running costs so far to justify the price. Instead, that comes from the IPS panel's evident image quality and superb connectivity stemming from Thunderbolt 4. This is a true docking station monitor, with all the options (including wired networking) you'd expect. **TIM DANTON**



ACER AMADANA 16APM1QJ

PRICE €119 inc VAT from acer.com
AVAILABLE Q1 2026

Generally I'm not a fan of portable monitors, finding them too clunky to deserve a place in my travel bag despite the benefit of having a second monitor in hotels. But the Acer Amadana 16APM1QJ may just have swayed me. It wins for both its compact dimensions and weight, both of which are reminiscent of a 13in tablet rather than a 16in device. Image quality also looks respectable – with the caveat that I haven't yet put it through our tests – and the price is hard to argue with. **TIM DANTON**



ACER CE270U Z

PRICE €699 inc VAT from acer.com
AVAILABLE Q1 2026

There are three things that strike you when you see the Acer CE270U Z in the flesh. The first is the raw visual power of a 26.5in OLED monitor. The second how slim the main panel is. And the third what a dull name Acer has given it. Acer CE270U Z sounds like a spare parts listing, not one of the most gorgeous products Acer has created. It's sharp in every way thanks to a 2,560 x 1,440 resolution and 280Hz refresh rate. Acer reckons that "content creators, movie buffs and gamers" will love it, and I can't help but agree. Especially with a 1,000cd/m² peak brightness in HDR mode. Add 3W speakers and it should sound the business, too. **TIM DANTON**

SAMSUNG'S TRANSPARENT OLED TECHNOLOGY GOES UP A NOTCH

Why on earth has Samsung stuck a water feature into its Displays area, I thought to myself. Then I realised: this was no water feature but a transparent panel within a glass box. You may be thinking so what, but a display panel that you can see through has a wide range of uses – from window panels that can show information through to stacked internal screens or partition walls.

The technology itself is quite amazing. It's a grid of LED display cells, all so tiny as to be almost invisible. The grid of wiring has to be super thin, too. Each cell emits its own light, so there's no need for light units down the side of the panel either, so you avoid the usual reflective and opaque back panel.

Samsung has been working on this tech for a while, as has its arch-rival LG. Previous versions have been transparent up to a point, but I've always thought "translucent" was more accurate. This new generation is really very clear indeed.

The brightness of the displayed images are eye popping, and they simply hang in mid air in front of you. And this gives you a clue for a future use. Scale this down by several orders of magnitude and you might be able to create a 4K panel that's the size of a lens in a pair of glasses. This is a huge ask, because such miniaturisation would be impossible with today's technology. But give it a few years, and it might just be possible to make it optically clear enough to work as prescription lenses, and also display very high resolution and brightness images directly in your field of view.

The technical challenge of this is almost mind bending. Getting that amount of tech onto a glasses lens is one thing. Keeping the power consumption and heat dissipation is another. Then offering this as a coating layer that can be placed into a sandwich for prescription lenses is even harder.

But they might get there. And this is a step on the way. **JON HONEYBALL**





GEEKY & GAMING

PLAUD NOTE PRO

PRICE £169 inc VAT from uk.plaud.ai

AVAILABLE October 2025

You may remember the Plaud Note: this credit-card-sized device can record conversations happening around you or calls directly on your phone. It then transcribes what it hears, with 300 free minutes per month; if you need more, you'll

need to stump up for the Pro subscription for £8.33 per month. At IFA, Plaud not only launched new hardware – the Note Pro includes a one-inch wide OLED screen that shows information such as battery life – but also improved software. This can create a mind map tracking the ebb and flow of your meetings, and analyse the characteristics of people within it. So if you're talking too much, or using a hectoring tone, it will tell you and make suggestions on how to improve. **TIM DANTON**



LENOVO LEGION GO GEN 2

PRICE \$1,049 from lenovo.com

AVAILABLE October 2025

This Windows 11-powered sequel to the Legion Go has an 8.8in OLED, detachable controllers, a more ergonomic design and AMD's Ryzen Z2 chip. The more rounded controller edges make it easier to hold than its predecessor, and I'm also a fan of the larger D-pad. It can be configured with a Ryzen Z2 or Z2 Extreme, and if leaked benchmarks are accurate it will be nearly 30% faster than its Z1 Extreme-powered predecessor. Combine that with AI features like upscaling and frame generation, and we could see some serious frame rates. **TONY POLANCO**



SUNLED SUNBOOSTER

PRICE To be confirmed

AVAILABLE To be confirmed

I saw a very early prototype of the Sunbooster at MWC Barcelona last year, when inventor and founder Dr Anne Berends was pitching the idea as a \$10 extra to new laptops – at the time she was hoping to persuade Dell *et al* to back it. The idea is that near-infrared light can bring mood and health boosts similar to being out in the sun, but without harmful UV rays. Dr Berends has since changed tack to standalone units, although sadly they're not yet in the pre-production phase where I can actually put the intriguing idea to the test. **TIM DANTON**

ACEMATE TENNIS ROBOT

PRICE £1,202 inc VAT from acematetennis.com

AVAILABLE Pre-order

There's only one problem with tennis: you need a partner. Ball machines are good for drills but you have to pick up hundreds of balls, and they don't allow you to rally as you would normally. Acemate, an incubator startup from Switchbot, has the answer to all lonely tennis players' woes, and judging from what I saw (and hit against) on the showfloor, it could be a revelation. The key to its responsive nature is a pair of 4K eyes that track your movement and the ball's, with an AI engine that gives it a fighting chance of catching the ball in its net before it fires back a shot. After your session, it turns all the data into a report – your net clearance, movement and even an idea of what you should work on to improve. It doesn't come cheap on pre-order, and will be even more expensive when it goes on full sale, but I love it. **TIM DANTON**



WE ARE REWIND GB-001

PRICE £379 inc VAT from

wearerewind.com

AVAILABLE Pre-order

The We Are Rewind GB-001 can do everything: it's a Bluetooth speaker, a wired speaker, a cassette player, a cassette recorder, an amp and a karaoke machine. Not only is it a multi-talented superstar, it also performs exceptionally well with ground-shaking bass and clear, defined treble without being tinny or pinching. There are individual dials on the speaker for even more customisation. This is an incredibly unique product that we're excited to get our hands on to review. **ERIN BASHFORD**

PERIPHERALS & NETWORKING

REOLINK TRACKFLEX FLOODLIGHT WIFI CAMERA

PRICE To be confirmed • AVAILABILITY To be confirmed

Using AI to recognise people wandering onto your property is nothing new, but this is the first time I've seen a device where everything happens on-device, as opposed to in the cloud or on a connected NAS. I spent quite a while on Reolink's stand watching its AI tag visitors in real-time, identifying them by age group, gender, clothing and even hairstyle. You can then search locally for suspicious characters; perhaps people you've already identified on the system. Add a high-quality 360-degree 4K camera, AI tracking, auto zoom and a pair of LED floodlights that push all the way up to 3,000 lumens and you have quite the package. The only detail this device wouldn't identify is how much it will cost and exactly when it will come to market, but if your interest is piqued then you can claim 10% off the final price by registering at tinyurl.com/374reolink. TIM DANTON



NETGEAR NIGHTHAWK M7 PRO

PRICE £900 from netgear.com

AVAILABILITY October 2025

I know what you're thinking: £900 for a mobile router is roughly £800 more than you want to pay. But what if your team needs access to a 5G signal and you want the solidity and range offered by Wi-Fi 7? This is the price you'll need to pay, and the Nighthawk M7 Pro can connect up to 64 concurrent devices with coverage up to 2,000 square feet. There's also a 2.5GbE port for wired connections, while USB-C is there for charging (Netgear says it lasts for up to 13 hours) or tethering. And when you're back at base, you can always use it as a day-to-day router. TIM DANTON



LENOVO THINKPAD THUNDERBOLT 5 SMART DOCK 7500

PRICE \$550 from lenovo.com

AVAILABILITY October 2025

This was one of three ThinkPad docks Lenovo revealed at IFA 2025. It also showed off the \$380 Thunderbolt 4 Smart Dock Gen 2 7500 and \$270 ThinkPad USB4 Smart Dock 5500, but the pricey Thunderbolt 5 option stands out due to its two DisplayPort 2.1 connectors, HDMI 2.1 port and dual downstream Thunderbolt 5 ports, meaning the dock can handle up to three 8K displays and a fourth 4K display (all at 60Hz refresh rates). And via the RJ45 2.5GbE port, the dock is compatible with Wake-On-Lan, PXE Boot and MAC Address Passthrough when connected to a ThinkPad. CALE HUNT



PHILIPS HUE SHINES BRIGHT AT IFA

Signify, the company behind Philips Hue, launched plenty of new products at IFA, including the long-awaited Philips Hue Bridge Pro, seamless light strips, a video doorbell and heaps of smart bulbs.

The £80 Bridge Pro essentially connects your Philips Hue devices. It can support over 150 lights (compared to 50 for the Philips Hue Bridge v2) and 50 accessories, and turns your Hue lights into motion sensors without any extra hardware. This technology is called MotionAware, and will work with almost all existing Philips Hue bulbs and lights that are connected to a Bridge Pro, not just new ones.

New ones such as Philips' Hue Essential range, a collection of affordable – albeit slightly dimmer – smart lightbulbs and strips. You can control their basic functions from your phone via Bluetooth or use a Philips Hue Bridge to unlock advanced features such



as scenes and automations, and trigger lights with timers, switches and sensors. Available now, Philips Hue Essential A19 bulbs and GU10 spotlight bulbs start at £20 each, Strip Lights start at £50 and Flex Strip Lights cost from £85.

In addition, Philips announced the Philips Hue OmniGlow, which will go on sale in Q4 of this year and cost £120 for a three-metre strip. Each strip is packed with tiny LEDs less than 0.5mm across, creating a seamless band of light, and can bend as needed.

Finally comes the Philips Hue Secure Video Doorbell, a 2K camera to rival Ring and its ilk. You can watch footage from your doorbell or camera live on your phone, and review videos from the last 24 hours for free. If you want to store your clips for longer than that, you'll need a paid-for Hue Secure subscription plan. The doorbell will cost £140, each chime unit £50, and it goes on sale from October 2025. CAT ELLIS



Build a home security system for under £20

Protecting your home or workplace doesn't need to be expensive.

Nik Rawlinson shows you how it's done

Home security systems can be complicated things. If you want to, you can invest in proximity and movement sensors, contacts that detect when doors or windows have been opened and multiple cameras all managed from a central hub.

Not everyone needs a full-scale surveillance system like that, however. Even a single camera can give you a huge boost in protection; while it may not cover every entry point, if you pick the right location it can watch over your most valuable possessions and alert you to any unexpected movement.

The best part is that good cameras can be very cheap, costing – as you might have guessed from our headline – less than £20 apiece. With most models that price even includes easy-to-use surveillance software, but this won't necessarily let you get the best from your camera: it may lock you into the manufacturer's cloud storage platform, or insist on saving to an onboard SD card, which is only accessible through the app itself. That's not ideal if you want full flexibility to manage and review your footage.

Luckily, there's another option. Provided that your chosen camera supports the industry-standard real-time streaming protocol (RTSP), you can access the feed using third-party streaming software and devices to view the footage on a TV screen, record it over the network and add more cameras over time, to progressively beef up your home security.

Choosing your camera

For our purposes this month we'll use a TP-Link Tapo C110 camera. This is a great choice for low-cost home security projects, as it has a decent three-megapixel resolution with a wide field of vision, automatic night-sight and integrated Wi-Fi – and you can pick one up on Amazon for just £18. There are, however, plenty of alternatives from many

other manufacturers, offering features such as higher resolutions, weatherproof housings and motorised pan, tilt and zoom controls.

Whichever camera type you're interested in, we'd recommend you choose one with a hard-wired power supply, rather than a battery-powered unit. Battery-only devices can run for weeks or months if they only "wake up" when movement is detected, but if you're buying a camera for security purposes you don't want to risk it running out of juice at the wrong time.

The other important thing is to ensure that your chosen camera supports RTSP. This standard was jointly developed by Netscape, RealNetworks (the name behind the RealPlayer media player) and Columbia University back in 1996, and it's still in use today for controlling streaming media servers of all types. Using RTSP, you can stream your camera footage directly to any device on your home network – and record it too, as we'll see below. Most importantly, choosing an RTSP-compliant camera means you're not locked into platform-specific services or subscriptions.

Whichever camera type you're interested in, we'd recommend you choose one with a hard-wired power supply



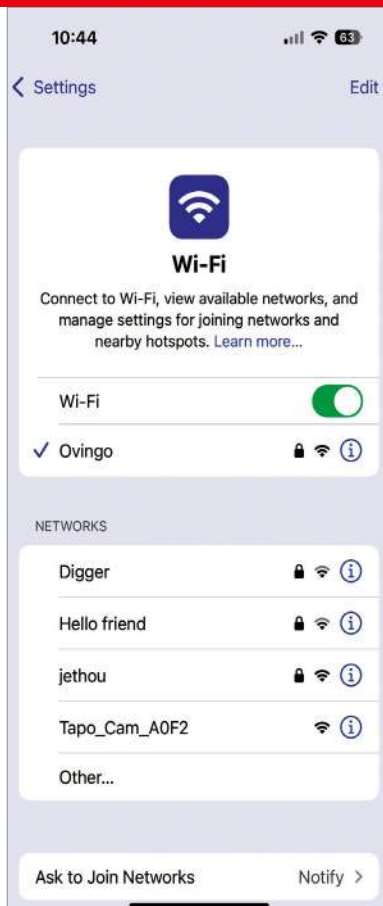
The trade-off is that enabling RTSP often means disabling other native features. Our Tapo C110 camera can upload footage to TP-Link's cloud storage and record video to a locally installed microSD card, but you can't have both of these features enabled and use RTSP at the same time.

Set up the camera

If you're using the same Tapo camera that we've chosen, start by installing the Tapo app on your phone – you can get it free from the Apple App Store or Google Play. Once the app is up and running, tap the "+" icon at the top of the screen, followed by Add Device. Tap Indoor Cameras, then Tapo C110.

Now plug in the camera and wait until the LED beneath the lens starts to flash red and green; this may take up to 30 seconds. When it does, return to the app and tap "Already Red and Green". Now switch to the Android or iPhone settings and open the Wi-Fi controls. Look for a network with a name that starts Tapo_Cam_ and join it. As you can see on the right, our camera is named Tapo_Cam_AoF2.

You'll know when the camera has connected to your network, as it will say "Wi-Fi connected" out loud. You



LEFT Set the camera up by connecting your phone to its wireless network

can then give the camera a meaningful name, specify the room in which you're using it, and give it an icon.

If you want to save footage to a microSD card as well as streaming it over your local network, insert the card now. TP-Link recommends Class 10 or higher cards with between 8GB and 512GB of storage. To ensure you don't hit compatibility problems, initialise the card in the app, rather than formatting it on your computer.

Enabling RTSP

You can now check that the camera is up and running by tapping its name in the Tapo app; after some orientation alerts you'll see a live view of its output. To allow external devices and apps to access this same live stream, you'll need to set up a username and password that those devices can use to connect to the camera.

To do this, tap the nut icon at the top of the screen to open the camera's settings, then tap Advanced Settings followed by Camera Account. The app explains what you're about to do and, on the following screen, warns you about the associated risks. If you're happy to proceed, tap "Understand and Agree", then set your credentials. ➔



	Brunt	B0:41:6F:06:49:50	192.168.0.210/24	1000	Ethernet 2
	Mac	2E:80:02:47:45:34	192.168.0.156/24	1000	Ethernet 3
	Richards-MBP-2	8C:85:90:C0:CF:68	192.168.0.49/24	1000	Ethernet 3
	rich	b8:27:eb:d9:1a:c3	192.168.0.30/24	1000	Ethernet 3
	C110	a8:29:48:14:a0:f2	192.168.0.74/24	1000	Ethernet 2
	iPad	F2:26:38:0E:62:D5	192.168.0.115/24	576.47	Wi-Fi 6G Digger
	unknown	5A:71:75:12:5E:07	192.168.0.69/24	576.47	Wi-Fi 5G Digger

For security, these should be different to the username and password you use to access the Tapo app or other accounts. Remember what you set, as you'll need to enter it later.

You've now done all you need to do to view your camera's output via RTSP – so long as you know where to find it on your local network. You can find the camera's IP address by going into your router's management interface and browsing the attached devices. If you're using the Tapo camera, you'll see its address alongside the name "C110".

You can use this address to view the stream over your home network – but note that, as your network will probably be using DHCP, this address might change over time, which could cause problems. It's a good idea therefore to "reserve" this IP address in your router's settings, to ensure that it's always assigned to the same device. You can also set a static IP address in the Tapo app; to do this, open the camera's settings in the Tapo app and tap Advanced Settings. Now tap Network Settings and tap the switch beside Static IP. Leave all other settings as they are and tap Save.

It's essential that you close the Tapo app at this point – if it's still communicating with the camera in the background, you may not be able to open the RTSP stream in any other application.

View the stream remotely

At last it's time to test the remote stream. There are dozens of apps that can display RTSP video, but we've chosen VLC as it's freely available for Windows, macOS and Linux. If you don't have this app, install it from videolan.org/vlc, launch it and press Ctrl+N to open a new network stream. Then enter the following address:

rtsp://192.168.0.74:554/stream2

12:04 Network Settings Save

Static IP ☒

Improper network parameters may cause your device to go offline or interfere with the normal operation of other devices on the same network.

IP Address
192.168.0.74

Mask
255.255.255.0

Gateway
192.168.0.1

DNS
194.168.4.100

Replace the IP address with the address of your camera on your local network, but keep the port number at the end (:554) – this is the standard connection method for RTSP stream. The Tapo supports three stream types, with stream1 offering the highest quality and stream3 using the least bandwidth. We've chosen stream2 as a good compromise for home security.

When VLC asks for your credentials, enter the username and password that you set for the camera account, not the details you use for your Tapo account. The player may now take a few seconds to open the video stream, after which it will start to play. You'll also hear any audio picked up by the camera's microphone, but note that this is a one-way stream. Although the Tapo camera does have a small integrated loudspeaker, the RTSP connection doesn't allow you to talk back to anyone who happens to be on the opposite end of the link.

Embed your feed in a web page

If you don't want to keep running VLC and entering your credentials to view the camera stream, you can embed it in a web page. Although most browsers can't natively handle RTSP streams, you can get around this using a free, open-source technology called WebRTC (short for Web Real-Time Communication).

The only slight catch with WebRTC is that it's not a native extension or Windows app; it requires a little manual setup and configuration. A neat way to get it running is to use a Docker container, so that all of WebRTC's associated files and settings are kept in one place, and we're not scattering files across our Windows drive, or adding to the Registry. It also means that if we want to add further cameras, we can just create additional containers.

In Windows, you can install Docker directly from the Microsoft Store. When it's finished installing, reboot your system and allow Windows to install or update the Windows Subsystem for Linux (WSL), which Docker requires. This may take some time. Once Docker is up and running, wait a few seconds more until the status line at the bottom of the Docker sidebar says "Engine running".

Now launch PowerShell from the Windows menu and type the following as a single line, replacing the variables in square brackets with your own settings. Replace "username" and "password" with the camera username and password that you set in the Tapo app:

```
docker run --name webrtc -p 8000:8000 -e RUN_ARGS="-u rtsp://username:password@IP_address:554/stream2" --restart unless-stopped -d mpromonet/webrtc-streamer
```

PowerShell may warn you that mpromonet/webrtc-streamer isn't installed locally, but don't worry: it will download and install all of the necessary components for you.

When it's completed, you'll see a new container in the Docker dashboard. This is where the streaming service lives. You can now view the video feed in a web browser, via WebRTC. To do so, just open a new browser window and point it at:

ABOVE The Tapo C110 has been assigned the IP address 192.168.0.74

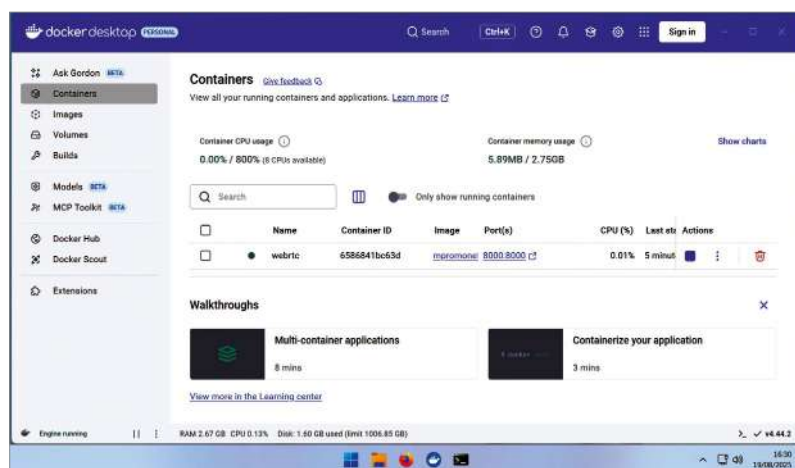
LEFT Giving the camera a static IP address makes it easier to find on your network

There are dozens of apps that can display RTSP video, but VLC is freely available for Windows, macOS and Linux

```
Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.

Install the latest PowerShell for new features and improvements! https://aka.ms/
PSWindows

PS C:\Users\nik> docker run --name webrtc -p 8000:8000 -e RUN_ARGS="-u rtsp://ni
krawlinson:tapotapotapo@192.168.0.74:554/stream2" --restart unless-stopped -d mp
romonet/webrtc-streamer
Unable to find image 'mpromonet/webrtc-streamer:latest' locally
latest: Pulling from mpromonet/webrtc-streamer
01f8eca57033: Pull complete
32f112e3802c: Pull complete
e66abe319423: Pull complete
5ba8ac9c63f9: Pull complete
b1351d7f8237: Pull complete
Digest: sha256:edf5832c50e8f422f0e8f96cbc26edf1b811f12943d62f31d42ccee9e27ff905
Status: Downloaded newer image for mpromonet/webrtc-streamer:latest
6586841bc63db5febaec691c0fd5469f2a16790d71544ff280523c625901ab27
PS C:\Users\nik>
```



http://localhost:8000/webrtcstreamer.html?video=rtsp://username:password@IP_address:554/stream2

Again, swap the username, password and IP_address for the credentials that apply to your setup, but leave the port (:554) and the local address (localhost:8000) unchanged. When the page loads, you should immediately see the stream from your camera.

Beyond your PC

You can access the stream from other computers on your local network by swapping "localhost" in the address above for the IP address of the computer managing the stream within Docker. You can find this by opening a command prompt and entering "ipconfig"; this command lists all the addresses associated with your computer's active wired and wireless network connections. Look for the entry beside IPv4 Address: in the screenshot on the right, that's 192.168.0.210. This is what we need to use in place of "localhost" in the address given above to display the stream on another computer on our local network.

Being able to view the stream on your local network is great if you want to see whether it's worth getting up to answer the front door, but less useful if you're out and about. To monitor the feed from beyond your

network, you'll need to set up port forwarding to send any incoming connections to the PC managing your stream, or to the camera itself. The process for doing this depends on your router, so you'll need to check the documentation; the key is that you need to redirect incoming http/https requests to the PC running Docker, which will need to stay switched on and awake around the clock. Again, it's a good idea to give it a static IP address, as if an automatically assigned address changes you won't be able to look it up remotely.

Recording footage

Watching footage is one thing, but unless you're peering at the screen around the clock you're unlikely to be watching at precisely the moment something notable happens. Recording the feed lets you review any suspicious incidents – and means you have a copy of the evidence.

If you have a NAS appliance, it may have built-in capabilities to record the stream from your camera. Synology's Surveillance Station software (tinyurl.com/374synnas) supports close to 9,000 IP camera models and other devices, enables mobile access, and can trigger real-time alerts if unexpected movement is detected. QNAP offers its QVR Client Pro (tinyurl.com/374qnapnas) for its

Recording the feed lets you review any suspicious incidents – and means you have a copy of the evidence

LEFT Setting up the Docker container downloads and installs the required components

LEFT The Docker container is now shown in our dashboard

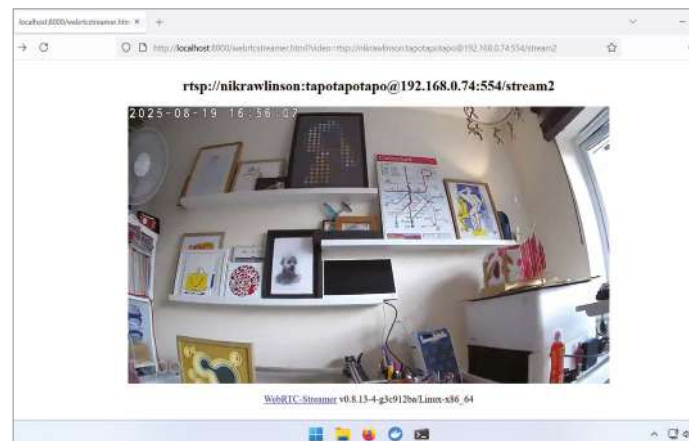
BELOW We used WebRTC to stream the output in a browser window

BOTTOM The ipconfig command reveals the various network addresses

own NAS devices, as well as for Windows and macOS.

Otherwise, you can use local software running on a spare PC. Security Eye for Windows (tinyurl.com/374seceye) is a free tool that lets you set up recording schedules, and can alert you via email or SMS when it detects motion. iSpy (ispyspyconnect.com) is another option with very low system requirements – just 2GB of RAM and 200GB of free drive space should be enough to host up to four cameras at fairly low resolution.

Finally, if you have a spare Raspberry Pi, you can easily install motionEye (tinyurl.com/374motioneye) through DietPi (dietpi.com). As well as supporting standard IP cameras such as our Tap model, it claims compatibility with most USB cameras, and can upload media directly to Google Drive and Dropbox, giving you a safe off-site repository for captured footage. ●



```
Command Prompt
Microsoft Windows [Version 10.0.26100.4946]
(c) Microsoft Corporation. All rights reserved.

C:\Users\nik>ipconfig

Windows IP Configuration

Ethernet adapter Ethernet 2:

Connection-specific DNS Suffix . . . : 
Link-local IPv6 Address . . . . . : fe80::1b4
IPv4 Address. . . . . : 192.168.0.210
Subnet Mask . . . . . : 255.255.255.0
Default Gateway . . . . . : 192.168.0.1

Wireless LAN adapter Local Area Connection* 1:

Media State . . . . . : Media disconnected
Connection-specific DNS Suffix . . : 

Wireless LAN adapter Local Area Connection* 2:
```




MYSTERIES OF IP

EXPLAINED



We rely on IP every day, yet most of us are hazy on the details of how it works. **Darien Graham-Smith** tackles common questions about addressing, routing, ports, packet sizes and more

From cheap home routers to enterprise data centres, every internet-enabled device runs on IP. Together with TCP – the protocol that allows remote systems to connect and reliably exchange data with one another – IP underpins our connected lives, and has been doing so for years. Whether you’ve wanted to or not, you’ve probably absorbed a certain working familiarity with IP.

When it comes to the finer details, though, things get more mysterious. A typical router interface offers any number of advanced settings whose meanings are far from clear, and while you may know that certain aspects of the setup need to be just so, the reason is rarely obvious. Let’s look at some of the more puzzling questions relating to IP – and at last get some understandable answers.

Why do all my IP addresses start 192.168...?

You probably know that all the IP addresses inside your home network are managed by your router, and that they’re only valid inside your network. So you might wonder why – at least when we’re talking about IPv4 – they all have to be in the seemingly random range of 192.168.x.x. Why not start at 1.1.1.1 and work your way up from there?

The simple answer is that way back in 1996 the Internet Engineering Task Force officially carved out a few specific address ranges – ones that weren’t already in use at that time – for use on private LANs. The IP address 1.1.1.1 isn’t included in one of these reserved blocks; it’s a public address that’s intended to be accessible from anywhere on the internet, and which currently happens to be owned by Cloudflare, which uses it to host a DNS service. If you tried to simultaneously give that same address to a device on your home network, the duplication would lead to major routing problems.

For this reason, routers restrict your network to designated blocks of private addresses, usually in the range between 192.168.0.0 and 192.168.255.255. This range allows for 255 x 255 = 65,536 unique addresses within a LAN; a few of these are reserved for particular purposes, such as the base address 192.168.0.0 which refers to the entire network, but that still leaves plenty of addresses for any home or small business.

Even so, this is actually the smallest of the three reserved ranges. Another one extends from 172.16.0.1 to 172.31.255.255, offering 1,048,576 LAN addresses, while the largest private range spans all the way from

10.0.0.1 to 10.255.255.255, allowing for more than 16 million devices in one private network. These huge ranges might be used by global companies such as Google or IBM, although they require careful segmentation and management, or the sheer volume of traffic becomes overwhelming.

This is why home routers generally stick to the smallest range – in fact, they normally default to using a subset of just 255 addresses within this range, which they assign automatically to connecting clients via DHCP (the dynamic host configuration protocol). Irritatingly, though, there doesn’t seem to be any consensus as to whether the default address space starts at 192.168.0.1 or 192.168.1.1 – that just depends on who made the router.

What is a subnet mask?

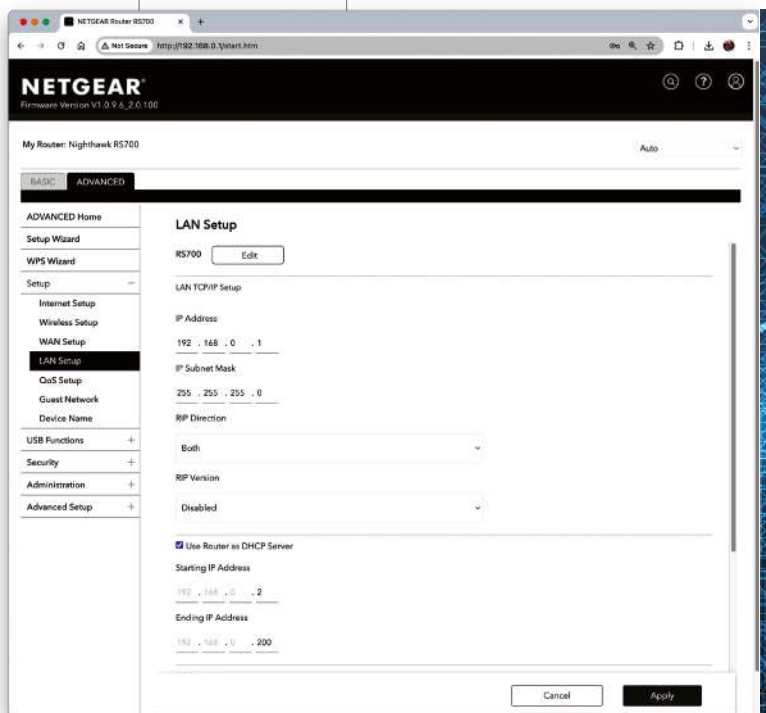
If you’ve ever configured an IP connection manually, you’ll have been asked to provide the address of the network gateway (your router), and also a subnet mask. For a home network this is usually 255.255.255.0 – but what does that mean?

Simply put, the mask defines which addresses are on the same subnet, meaning they’re “local” and able to connect directly to each other. Where you see a value of 255, that means that this part of the IP address needs to match the gateway’s own IP address in order to be local; a zero means that a unique number (or combination of numbers) goes here to specify the device’s individual address.

If that sounds confusing, you can normally just remember that the standard 255.255.255.0 mask means that all addresses from 192.168.0.1 to 192.168.0.255 are local to each other; if your netmask is 255.255.0.0, addresses from 192.168.0.1 to 192.168.255.255 will be treated as local.

Behind the scenes, masks are based on binary representations of IP addresses. A netmask of 255.255.255.0 corresponds to four binary octets (bytes), with values of 11111111.11111111.11111111.00000000.

BELOW You can choose the address range your router uses – within limits



Whether you wanted to or not, you’ve probably absorbed a working familiarity with IP

The bits that are set to one define the network prefix, which must be the same for all local hosts, while zeros indicate the bits that are used for addressing.

A mask can never contain a mixture of ones and zeros. It must always start with some number of ones, followed by zeros for the rest of its 32-bit length. However, the switch from ones to zeros doesn’t have to align with the byte boundary: you could, for example, use a mask of 11111111.11111111.11111111.11000000 (255.255.255.192) to define a local address space of six bits, allowing for values between 1 and 64. For a bigger network you could use 11111111.11111111.

11111100.00000000 (255.255.252.0), giving you 1,024 available addresses.

Another convenient way to define address ranges is with a model called CIDR notation. This stands for “classless inter-domain routing” – classless because it replaces an old system that formally divided up the entire IPv4 address space into fixed-size “classes”.

CIDR handily combines the base address of the network and the size of the network prefix into a single expression, separated by a slash. So, if your router uses the 192.168.0.0 address range with a mask of 255.255.255.0, that becomes 192.168.0.0/24 in CIDR notation. If you don’t need so many clients, you could shrink the address space down to 192.168.0.0/25, using only the seven rightmost bits for addressing, with values running from 192.168.0.1 to 192.168.0.127. If you wanted, you could then set up a second subnet to start right after the first, defined as 192.168.0.128/25.



Are subnets and VLANs the same thing?

Most business routers – and some home ones – let you set up virtual LANs within your home network. Superficially, these seem a lot like subnets, as they divide up the available address space into separate segments. However, while devices on different subnets can normally see and communicate with one another via the router, VLANs are segmented at a more fundamental level, and behave as if they were physically separate networks.

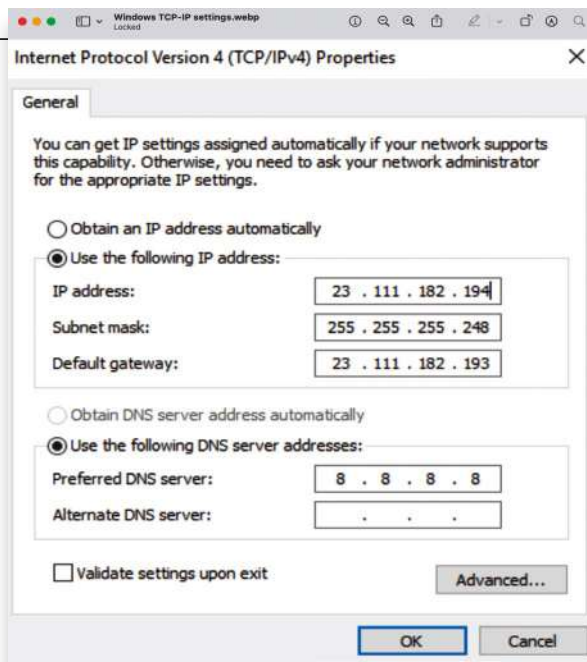
These different segmentation models are useful for different things. Subnets are ideal if, for example, you want to monitor traffic passing between clients and internet-facing servers; VLANs are better when you want different groups of devices to be completely isolated. For example, many home routers will let you set your guest network as a VLAN, so that connected devices can access the internet, but have no access to devices on the main home network. There may also be a dedicated VLAN for your smart lightbulbs and power sockets, with its own SSID – so that if someone compromises their security, they can't use them as stepping stones to break into more sensitive computers and NAS appliances.

Whatever happened to IPv6?

It seems we've been talking about IPv6 forever, so no doubt you already know the idea behind it. The 32-bit address space of IPv4 only allows for around 4.3 billion unique addresses, which isn't ideal in an increasingly connected world of eight billion people. IPv6 solves that problem by allowing for 2^{128} unique addresses, or approximately 34 followed by 37 zeros. That's enough to give an IPv6 address to every speck of space dust in the known universe.

Yet somehow, 30 years after it was invented, IPv6 is still hanging around on the sidelines. Rather than embracing a costly, complex global changeover, we've eked out the supply of IPv4 addresses through measures such as network address translation – where every device on your LAN shares a single external internet address – and precise ranging with CIDR, so that networks don't have to occupy more address space than they need.

Things have also been helped by the rise of carrier-grade network address translation (CGNAT), which allows ISPs to share one external IP address across any number of subscribers. This isn't universally popular, as it breaks port forwarding – as we'll discuss below – but it certainly reduces the pressure on IPv4



addresses. Some estimates suggest that 10% of home broadband connections are using shared CGNAT addresses, and likely a much higher proportion of mobile connections.

Yet it would be a mistake to think that IPv6 has flopped. Most modern routers can run IPv4 and IPv6 in parallel, and today's laptops and smartphones will happily operate on "pure" IPv6 networks; if you wanted you could turn IPv4 off right now. The major obstacle is that not all ISPs support IPv6 connections, and in your own home you'd lose access to any legacy devices such as printers, games consoles and smart home gadgets that aren't yet ready for IPv6.

Still, support is gradually becoming more widespread. There will probably come a day in the next decade when you can fully switch over to IPv6 with zero disruption. For many people it may happen when a new router or firmware update turns off IPv4 services, and they won't even notice it.

How does port forwarding work – and what is UPnP?

IPv4 address translation is fine for most domestic purposes, but it only works when the connection is initiated from inside the private network. If you want to run a server

inside your home network that's capable of accepting unsolicited connections from over the internet then you've got a problem: a remote client can send a connection request to your router using your external IP address, but it has no direct way of specifying which particular device within the private network it wants to contact.

Port forwarding solves this problem by taking advantage of the fact that TCP/IP connections must specify not only a destination address but also a virtual port number, ranging from 0 to 65,535. Any computer service that accepts incoming connections can – indeed must – listen only on specified ports; this means you can offer multiple services from a single network address, perhaps all running on the same computer, with no interference or conflicts.

To configure port forwarding, you simply tell the router that requests for a specific port should be forwarded to a specific address on the local network. For example, if you want to run a web server on your home computer, you can configure your router to forward all requests on port 80 – that being the standard port for HTTP connections, as defined by the Internet Assigned Numbers Authority.

You're not forced to follow standard port numberings, but changing them willy-nilly could result in conflicts or blockages. The one reason you might want to do so is if you want to run, say, two web servers on the same LAN; the router can only map one port to one client, so if you want to run two servers of the same type they have to be on different ports.

If you think this all sounds a little tiresome, you're not alone. In 1999 a technology called UPnP ("universal plug 'n' play") was introduced which allows applications to talk directly to the router and automatically configure their own port forwarding rules, so server software "just works" with no manual configuration. It can also remove the need for port triggering, where the router forwards inbound connections on a specified port to whichever LAN client has an active outbound connection open on a different port – useful for some games or communications services.

However, while UPnP takes some of the pain out of network configuration, security experts often recommend disabling it. Since the technology doesn't use any sort of authentication, in theory it could be abused by malware to open up ports on your router that could then be exploited by a remote attacker.

As we've noted, port forwarding also fails if your ISP is using CGNAT

TOP The subnet mask defines which addresses are local to your network

ABOVE Most routers nowadays support IPv6 – if you want them to

– because when someone tries to connect to your external IP address, the ISP's own router doesn't know which of the hundreds of customers using that address they're trying to reach. The best solution, if your ISP and router permit it, is to use IPv6: since IPv6 addresses are globally unique, any device can connect directly to any other from anywhere, with no need to mess around with address translation or port forwarding, as long as there aren't any firewalls or other technical obstructions in the way.

What is an MTU, and can it speed up my internet?

Sometimes you'll see someone online complain that their internet connection is running slowly, and someone else will suggest changing the MTU. This is a much-misunderstood setting that's applied at the network controller – so each device on your network will have its own MTU value, as will the router.

The abbreviation stands for maximum transmission unit, and it determines how much information is packed into each IP packet that's transmitted over an Ethernet or Wi-Fi connection. The default for an Ethernet connection is 1,500 bytes, although for some types of DSL internet connection it's 1,492 bytes (because the connection itself entails a small overhead). Some wired networks allow "jumbo frames", containing up to 9,000 bytes of data per packet.

MTU can make a palpable difference to performance. The smaller your MTU, the more packets must be sent to convey a given quantity of data. This wastes bandwidth, as each packet needs to contain a header, containing information such as the source and destination IP addresses, as well as your block of payload data.

If you make the MTU too large, however, you can run into problems with the internet servers that are supposed to forward your data to its destination. These aren't designed to handle huge chunks of data, and may reject oversized IPv4 packets, asking for them to be "fragmented" into smaller ones – leading to a greater processing overhead and a slower overall experience. You could even run into a "black hole" scenario, where the originating network controller doesn't realise that an upstream router can't process its packets, so the transfer is never completed and the transmission just times out.

To find the best MTU for your internet connection, you can use the

ping command from the Windows command prompt as follows:

ping 1.1.1.1 -f -1472

This "pings" the Cloudflare DNS server we mentioned above (although you can use any internet server) with a specified packet size of 1,472 bytes – equivalent to 1,500 bytes once the standard IP header for a ping request has been added.

If you get an error message saying "Packet needs to be fragmented", you know that something along the way is breaking up your packets. Experiment with turning it down until you get a successful response, then set the MTU for that interface to the specified packet size, plus 28 bytes. To do this, find out the name of your internet connection by entering:

netsh interface ipv4 show subinterfaces

Then enter this command, substituting the name of your network connection for "Local Area Connection":

netsh int ipv4 set subinterface "Local Area Connection" mtu=1492 store=persistent

Should I hide my IP address?

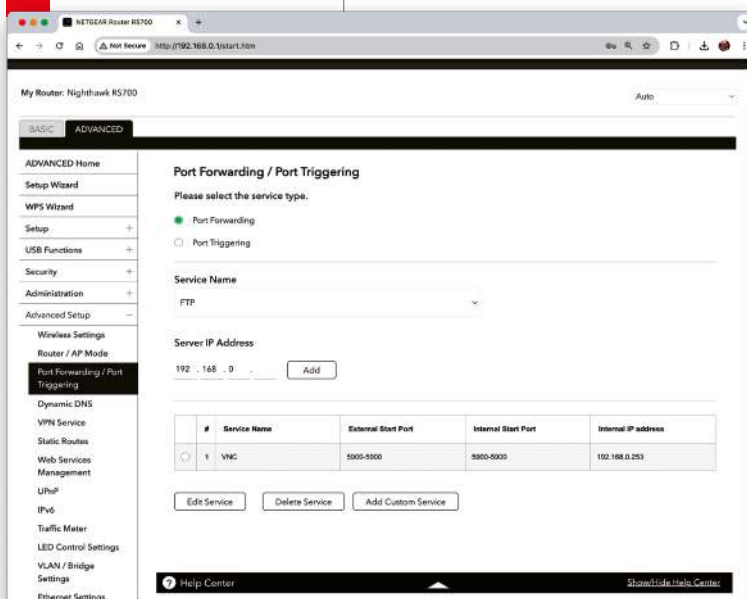
Some commentators will warn you that it's risky to expose your IP address online. At the same time, many of these commentators are trying to sell you anonymising VPN services – so what's the truth?

The nightmare scenario is that someone might use your IP details to track down your name and address, and show up at your home to assault or rob you. Don't panic, though – that's not a realistic threat. It's true that your external IP address can be used to identify your ISP, by checking the public record of which company it's registered to, and by combining this with routing information it's possible to guess

If you want to avoid tracking, the easiest solution is to use a commercial VPN service

at what town or city you're located in. However, unless you're using a very small, local ISP, the IP address is unlikely to reveal anything more specific than that. To check this for yourself, visit a free geo-IP detection website such as ipgeolocation.io and see what it says.

It's slightly more plausible that someone who knows your IP address could target you for a brute-force attack, spamming your router with connection attempts to see if they



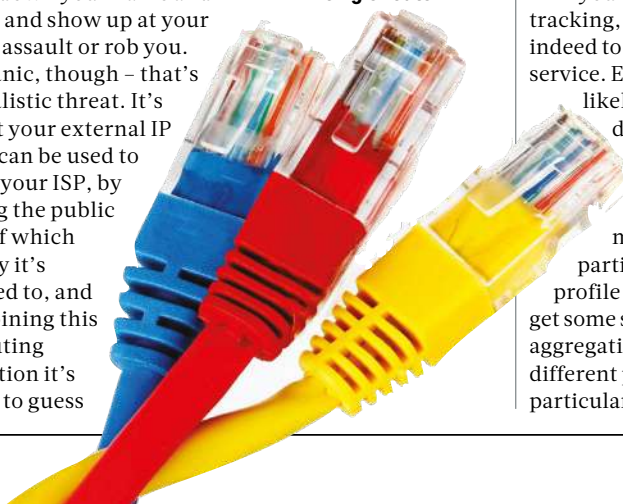
ABOVE Port forwarding lets external devices connect to ones inside the network

BELOW VLANs let you run separate networks on a single router

can get access to your network. This, however, would involve a focused effort for a very uncertain reward – opportunistic scammers are more likely to cast their nets more widely, using mass phishing attempts or malware attacks that don't rely on IP addresses.

The biggest concern is "fingerprinting", where remote servers build up a profile of you, based on activity linked to your IP address. As well as the main site operators, advertisers can pick up the fact that you saw a particular advert while visiting a particular site at a particular time. Is this dangerous? Probably not in any physical sense. Is it creepy and annoying? You bet.

If you want to avoid this sort of tracking, the easiest solution is indeed to use a commercial VPN service. Each time you connect you'll likely be routed through a different server with a different IP address (even if you pick the same geographical region). That makes it impossible for third parties to build up a consistent profile of you – although they may get some strange ideas if they try aggregating their data from all the different people who've used that particular server at various times.



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Lenovo ThinkBook G6 Plus Rollable

A brilliant innovation from Lenovo, the only question being whether it's worth the price in pounds (in both senses)

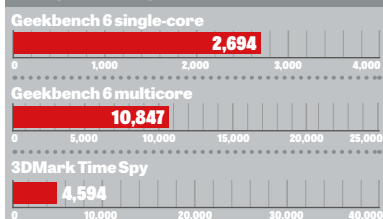


SCORE ★★★★★

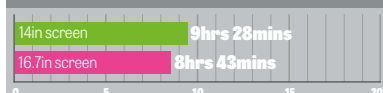
PRICE £3,083 (£3,700 inc VAT)
from lenovo.com

As we mention in this month's IFA 2025 coverage (see p32), Lenovo loves to show off wild concept devices at the big tech shows. Most of the time, they never move out of concept stage, making the Lenovo ThinkBook G6 Plus Rollable something to celebrate. What I saw in concept form at CES in January has turned into a real, buyable product.

BENCHMARKS



BATTERY LIFE



The question now is whether you should spend your cash on it.

Out of the box, the ThinkBook looks like a standard laptop, to the point of being dull. It has a two-tone silver finish, with the only clue to its talents being the odd bezels: wider on the sides than on the top and the bottom. But press the “up” button tucked into the top row of keys and the screen magically grows, shifting from a 14in 5:4 aspect ratio to a 16.7in display with an unusual 8:9 ratio. That’s equivalent to two 16:9 panels, one atop the other.

The first time you press the button it feels absolutely magical. Imagine that sensation you had of unfolding a Galaxy Fold the first time and then multiply it by five. Lenovo even offers a feature that lets you use your hand and the time-of-flight sensor to raise and lower the screen, but in practice it’s finicky. I stuck to the button.

The motor isn’t loud, but it does take time to roll and unroll – about nine seconds from button press to full extension or contraction. I’d like to see that cut in half, though I don’t know what that would do to durability. When Lenovo announced the laptop at CES, it claimed 30,000

ABOVE The innovative ThinkBook G6 Plus Rollable will certainly make heads turn

“Press the ‘up’ button and the screen magically grows, shifting from a 14in 5:4 aspect ratio to a 16.7in display with a 8:9 ratio”

hinge openings and closings and 20,000 screen rolls up and down. That’s comforting, but it’s yet another thing that can go wrong once the single year of warranty is up.

■ Screen time

As with all foldable and bendy devices, this is an AMOLED panel. That means rich blacks and, in this case, excellent colour coverage: well beyond the DCI-P3 space. A peak

brightness of 381cd/m² is less special, but the perfect contrast of OLED technology means that it will appear bright even at far lower settings.

That said, this isn’t a great choice for multimedia. Even at its default 14in size, movie trailers had thick black bars on the top and bottom. Those increased to obscene amounts with the taller 16.7in screen unrolled.

What these squarer aspect ratios do allow for is strong multitasking. The homepage of *New York Magazine* showed an almost overwhelming amount of text. And with the screen extended, I could use the top half for a Google Doc while using the bottom

of the screen to keep an eye on Slack, or have a team meeting up at the top of the screen while still getting some work done on the bottom. Plus there are uses for tall displays; some coders love a desktop display turned vertical to show more text (see the BenQ RD320U on p69 if that appeals).

There are limitations to the screen. For one, it doesn't support touch. Additionally, the hinge only goes just past a 90-degree angle. This ensures the screen rolls and unrolls at ideal angles, but I found it limiting. For instance, it's not good for lying on the couch with the system in your lap. You also have to be careful: if you attempt to shut the laptop with the 16.7in display unrolled, you'll be greeted with a faint but annoying alarm until you open it again.

You can't change the resolution in Windows 11 on this laptop either. Try this and a pop-up appears saying: "The current model does not support resolution adjustment" as Windows reverts to the native resolution whether you tell it to or not. You can still change scaling, though Lenovo warns it could cause problems with the ThinkBook Workspace app, as covered below.

The other issue is that at certain angles, you can see where the screen bends to fit in the laptop. This is similar to the way you can sometimes see the crease on foldable phones, but it doesn't feel terribly premium.

■ Soft options

Lenovo includes several pieces of software designed specifically for the rollable display, but none is strictly necessary. The big one is ThinkBook Workspace, which lets you add mini apps such as your reminders, to-do-list and calendar from your Microsoft account. The app also features a user guide, an awkward secondary virtual display, and access to Smart Copy, a clipboard manager. You can pin your own apps to Workspace's thick title bar too. I preferred using Windows 11's Snap Layouts to put apps where I wanted them on the screen to the point where one of the first things I did with Workspace was prevent it from launching every time I extended the screen (there's an easy-to-use keyboard button for it).

ThinkBook Workspace has a ton of buried settings, many of them turned off by default. If you want a fun animation to play while you extend the screen (which I wouldn't recommend, as it covers your work) or want to try the feature to raise the screen with your hand, you'll have to dig around in the settings.

There's also Lenovo AI Now, a local AI app that lets you feed documents into your

"personal knowledge base" and then use natural language search to interrogate it (much like ChatGPT). And, just like Lenovo's other devices, Vantage is on board for warranty information, plus easy access to your serial number

and device settings. This is also the place to come for system updates, which are worth checking for an unusual product such as this.

There's also Lenovo Smart Meeting, which makes adjustments to your camera and background, or replaces you with a temporary avatar if you have to leave a meeting. And while the 5MP camera isn't amazing – I saw grainy artefacts despite the high-resolution image – this reveals one of the hidden benefits of such a tall screen. With it unfurled, the webcam is roughly at eye height, so you can look straight at the camera. There's a shutter switch directly on the top of the camera bump, too.

■ Final thoughts

There's only one configuration of the ThinkBook Plus Gen 6 Rollable: an Intel Core Ultra 7 258V processor, 32GB of RAM and a 1TB SSD. There were no surprises in our tests, with strong performance in single-core tasks, weaker results in multitasking and plenty of gaming potential.

ABOVE The extendable AMOLED screen is ideal for browsing long documents

An extra few inches of screen didn't affect battery life as much as I expected, with a result of 9hrs 28mins in its compact form and 8hrs 43mins with the screen unfurled. These are solid rather than strong results, but at 1.7kg this is a heavy laptop by modern Ultrabook standards.

The good news is that the 66Wh battery is removable. You must

remove eight Torx screws to get inside, and I suggest following Lenovo's directions carefully, but the fact you can do so at all is great to see in such a complex device. The SSD is also replaceable.

"Should you buy this quite incredible device? I would be cautious, especially as there's no obvious way to extend the warranty"

LEFT The laptop ships with lots of software designed specifically for the rollable display

So, should you buy this quite incredible device? I would be cautious, especially as there's no obvious way to extend the warranty at time of purchase. And while there's nothing quite like the Rollable, you can buy twin-screen laptops such as Lenovo's Yoga Book 9i (see issue 372, p56), or foldable offerings such as the ThinkPad X1 Fold 16 (see issue 355, p58).

You could also buy any number of traditional laptops with similar specs plus a portable monitor for much less money. But the ThinkBook Plus Gen 6 Rollable is easier to carry, so if you're willing to pay the extra in terms of price and weight then this laptop's unique design makes it a standout choice. **ANDREW E FREEDMAN**

SPECIFICATIONS

8-core (4 P-cores, 4 LPE-cores) Intel Core Ultra 7 258V processor • Intel Arc 140V graphics • 32GB LPDDR5X-8533 RAM • 14in/16.7in 120Hz OLED touchscreen, 2,000 x 1,600/2,000 x 2,350 resolution • 1TB M.2 PCIe Gen4 SSD • Wi-Fi 7 • Bluetooth 5.4 • 5MP IR webcam • 2 x Thunderbolt 4/USB-C 4 • 3.5mm combo jack • 66Wh battery • Windows 11 Pro • 304 x 231 x 19.9mm (WDH) • 1.7kg • 1yr C&R warranty • part code 21TR0000UK

BELOW Connectivity is limited to two Thunderbolt 4/USB-C 4 ports

How we test

Laptops and PCs

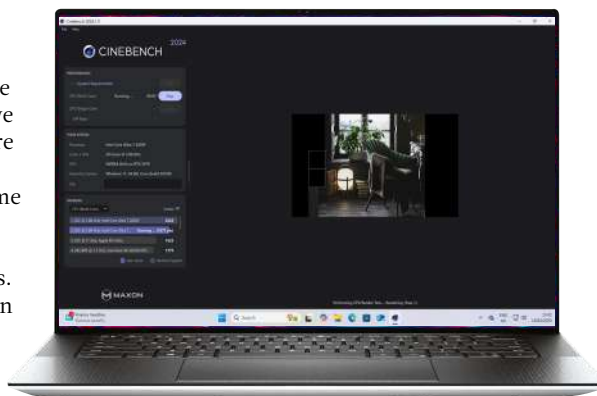
We run a selection of benchmarks on all the PCs and laptops we test. Where possible, we use a cross-platform test so we can compare Windows and macOS machines, which is where both Geekbench and Cinebench come into play. Both push the CPU to its limit, exposing how well cooled a system is.

We run extra tests for Windows systems.

We use PCMark 10 to benchmark systems in office tasks, content creation and basic tasks such as web browsing and video calls. We also run 3DMark Time Spy and *Shadow of the Tomb Raider* as a

minimum. We test laptops and PCs that include discrete graphics with a range of games, such as *Metro Exodus Enhanced* and *Dirt 5*.

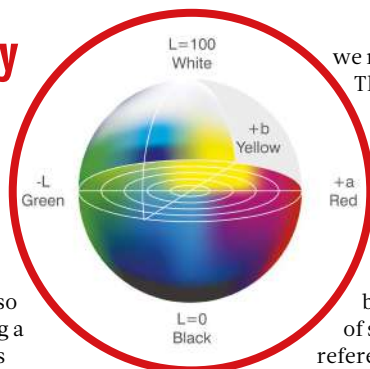
For laptops, we test battery life with Wi-Fi on and the screen brightness set to 150cd/m². We fully charge the laptops and drain them until they reach 5%. For Windows laptops, we will use a mix of PCMark 10's light-use and video-based tests, or a web surfing benchmark where a laptop automatically visits sites until the battery dies. We also use this test for MacBook.



ABOVE We put PCs and laptops through our intensive set of benchmarks

Screen quality

In each laptop, phone, tablet and monitor review, you'll see our conclusions about the screen quality. Some of this will be subjective, but we also test each screen using a X-Rite Display 11 Plus colorimeter. We measure maximum brightness, colour accuracy and (for monitors)



we run Geekbench 6. This is a good test of the processor and memory in particular, and include both a test for single-core and multicore performance. See below for a selection of scores to provide a reference of what's good... and what's not so good.

We also run 3DMark Wild Life test to give a measure of gaming performance.

We test tablet battery life by playing a full-screen video until the battery runs out with the device. To simplify the test, we use Airplane mode. We set the brightness to as close to 150cd/m² as we can get in the device's settings. We also put phones through a set of real-world and labs-based tests.

LEFT We use a Display 11 colorimeter to measure sRGB gamut coverage and Delta E

BELOW We play a video with the screen set to 150cd/m² to test battery life



consistency – there may be a difference in, say, brightness from the middle and the edges of the panel. We also measure Delta E, which is a guide to how accurately panels display colours. Anything under 1 is excellent and likely to be difficult for the human eye to distinguish; between one and two is still strong; above this suggests a panel that you shouldn't trust for colour-accurate photo editing.

Phones and tablets

We run a selection of publicly available benchmarks on all the phones and tablets we review. First,

GEEKBENCH 6 (SINGLE CORE)

Google Pixel 8a Tensor T3, Mali-G715s graphics	1,581
Google Pixel 7a Tensor T2, Mali-G710 graphics	1,408
Samsung Galaxy A55 Exynos 1480, Xclipse 530 graphics	1,161
Samsung Galaxy A35 Exynos 1380, Mali-G68 graphics	1,015
Samsung Galaxy A54 Exynos 1380, Mali-G68 graphics	996

HIGHER IS BETTER

What our awards mean



Recommended

This, quite simply, is a product we recommend you buy – if it meets your needs.



A-List

The best buy in its category right now. The product will also feature on our A-List, starting on p14. It's updated each month.



Labs Winner

Each month we run a group test, or Labs. This product has managed to beat all others to top position.

Tinyurl.com links

Throughout the magazine you'll see tinyurl.com shortcuts. Enter these into the address bar of your browser and it will take you to a particular page, which will either be too long or awkward for us to publish or will take you to the precise shop from which to buy. If it's Amazon, note that we may have an affiliate deal in place so we will receive a commission from each sale. This will never affect our verdict of a product, and if another reputable vendor is selling the product cheaper than we will use that instead.

Prices will vary

Prices we publish are correct on the day we publish, but we often see prices change, especially on sites such as Amazon. However, we do work with British PC retailers to ensure the prices we quote for their systems are correct. If the price isn't being honoured, contact us via letters@pcpro.co.uk.

Lenovo ThinkPad X1 2-in-1 Gen 10 Aura Edition

Yet another classy ThinkPad X1 with excellent battery life, but consider the X1 Carbon instead

SCORE ★★★★★

PRICE As reviewed, £2,000 (£2,400 inc VAT) from [lenovo.com](https://www.lenovo.com)

Compared to the Lenovo ThinkBook Rollable G6 (see p48), the Gen 10 update to the ThinkPad X1 2-in-1 is thoroughly boring. Grey aluminium top and bottom; what a yawn-fest. And how predictable that it's been upgraded to the 200V series of Intel chips from last year's 100V series, bringing support for Microsoft's Copilot+ PC scheme. In terms of novelty, this laptop is duller than a John Major biopic. In terms of a business rollout, on the other hand, it's exactly what IT managers and users demand.

That assumes the intended user will take advantage of the 2-in-1 form factor. If not, then the X1 Carbon (see issue 370, p52) makes much more sense due to its 1kg weight: I immediately noticed the difference when holding this 1.3kg device. Some of that extra weight stems from the hinge mechanism, which is as smooth as ever, but remember to order the £20 stylus or it will be a waste of mass and money.

You can order the X1 2-in-1 with three different screens: a low-power IPS panel with a 1,920 x 1,200 resolution, which will cut £90 from the price above; a 1,920 x 1,200 IPS panel with a privacy filter that will

add £140 to the price; and the 2,880 x 1,800 OLED panel on our unit. This hit all the right notes in testing, with 99% coverage of the DCI-P3 gamut, excellent accuracy and a peak brightness of 525cd/m², but whites only looked convincing at a specific viewing angle (with the screen at around 110 degrees).

As with the X1 Carbon, the X1 2-in-1 uses a low-profile version of Lenovo's scissor-switch technology with 1.5mm of travel compared to the 1.8mm of older models. It isn't as satisfying, but there's still plenty of feedback on key presses, and you benefit from a double-height Enter key and spaced out cursors. I only wish Lenovo could find a new home for the PgUp and PgDn keys as I kept hitting these instead of the left and right cursors. The haptic touchpad is excellent, but if you choose this £30 option then take time to investigate all the settings. You may get on better with a "light" touch to activate clicks, for example.

There were no surprises in terms of performance. The X1 2-in-1 ships with either the Core Ultra 7 258V or 268V, with the only difference for the latter being an ever-so-slightly higher peak frequency for the four P-cores and support for vPro. It also adds £150 to the price. Both

ABOVE The X1 2-in-1 is an unexciting laptop but could work well for business rollouts

LEFT Lenovo offers a choice of three different screens

"Add a three-year on-site warranty, plus EPEAT Gold and TCO gen 10 certification, and business buyers can buy with assurance"

BELOW It comes with a reassuring mix of old and new ports

chips include 32GB of integrated DDR5 RAM, but you can choose 512GB, 1TB or 2TB of stupendously fast PCIe Gen 5 storage. Our 1TB sample delivered 14,221MB/sec sequential reads and 13,473MB/sec writes in CrystalDiskMark 9.

Single-core performance from the Core Ultra 7 258V proved predictably strong, while its multicore scores were thoroughly average by modern standards. The built-in NPU brings support for Windows Recall and hopefully many more applications over time, but the most visible benefit for now is the almost perfect portrait blur it adds to video calls. This gives yet more appeal to a brilliant 8MP built-in webcam.

Battery life is another strength. A result of 16hrs 34mins in our light-use tests indicates that the X1 2-in-1 will easily last a day of far tougher usage, which is impressive for a 57Wh battery and an AMOLED panel. As with all recent ThinkPads I've tested, it's easy to replace the battery, the SSD and the Wi-Fi 7 WLAN module. Add a three-year on-site warranty and numerous options to extend your cover, plus EPEAT Gold and TCO gen 10 certification, and businesses can buy with confidence.

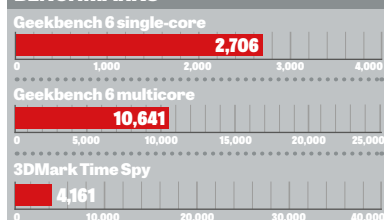
Lenovo also supplies a reassuring mix of old and new ports, with Thunderbolt 4 on the left and USB-A plus HDMI on the right, not to mention options to add 5G (antenna alone or with WWAN card), NFC and surprisingly competitive prices for Adobe software. If I were to buy this 2-in-1 I'd save money by choosing the

IPS panel rather than OLED, but my ultimate advice is to buy the X1 Carbon instead – unless you have an absolute killer need for a 2-in-1 design. **TIM DANTON**

SPECIFICATIONS

8-core (4 P-cores, 4 LPE-cores) Intel Core Ultra 7 258V processor • Intel Arc 140V graphics • 32GB LPDDR5X-8533 RAM • 14in 120Hz OLED touchscreen, 2,880 x 1,800 resolution • 1TB M.2 PCIe Gen 5 SSD • Wi-Fi 7 • Bluetooth 5.4 • 5G • 8MP IR webcam • HDMI 2.1 • 2x Thunderbolt 4/USB-C 4 • 2x USB-A 3.2 Gen 1 • 3.5mm combo jack • 57Wh battery • Windows 11 Pro • 313 x 218 x 16.2-18.3mm (WDH) • 1.3kg • Lenovo Yoga Pen • 3yr on-site warranty • part code 21NU001TUK

BENCHMARKS



BATTERY LIFE



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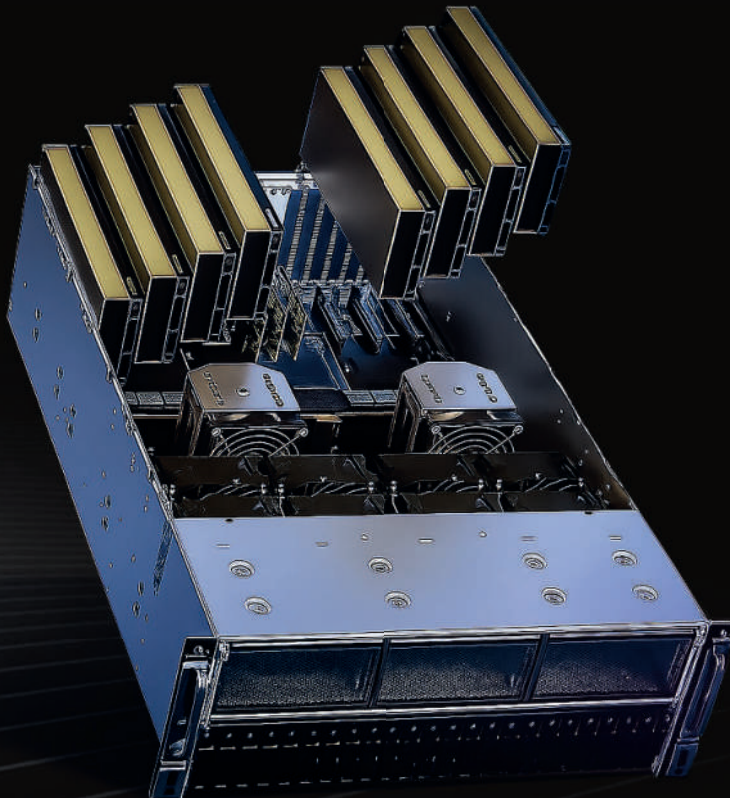


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Lenovo Chromebook Plus Gen 10 (14in MediaTek)

The best Chromebook yet thanks to its gorgeous OLED screen, strong performance and AI-enhanced skills

SCORE ★★★★★

PRICE £458 (£549 inc VAT)
from lenovo.com

By nature, I'm not a Chromebook lover. My take for years has been that you're better off spending a little more on a Windows laptop or MacBook with more features. So it was with some reluctance that I put away my MacBook and switched to the Lenovo Chromebook Plus as my work system for a week. Turns out that all it took was those seven days to make me a full Chrome OS convert.

Part of this is the power on offer. As Chrome OS is a simplistic system to run on, laptop makers typically compromise on the system specs. That means they're usually zippy enough for daily tasks, but they can quickly crumble under multitasking pressure. This often shows in reduced battery life, too.

The Lenovo Chromebook Plus 14 is built differently, primarily due to MediaTek Kompanio Ultra 910 chip and 12GB of RAM. The Kompanio Ultra includes a 50 TOPS NPU, making this the first Chromebook to have its own AI brain for tasks such as photo editing and video blurring.

Chrome OS is already the best choice when it comes to sneaking AI into your workload, as it adds this into the right-click options contextually rather than overlaying it clumsily on

everything. In particular, NotebookLM has become an incredible thinking partner for me across everything I do (it's also a fantastic tool for students), Gemini is a top tier chatbot service and, while I'm sure Veo 3 – Google's AI video generation model – could have its place in professional video workflows, I simply had fun with it.

Then there's the fact you have worry-free battery life, courtesy of a 60Wh battery. Much like the M4 MacBook Air, the Chromebook Plus 14 can run at an impressive sustained speed without the need for a fan.

So it's a great worker: what about entertainment? Once again, this laptop delivers.

It starts with a gorgeous, vivid 14in OLED. This couples excellent accuracy (its average Delta E was 0.19) along with deep, inky blacks and 84% coverage of the DCI-P3 gamut, which is fantastic immersing yourself in your latest Netflix binge watch. Topping it all off are a set of speakers that even give MacBooks a run for their money. They're loud, clear and bring plenty of warmth to the lows.

Let's not forget the fundamentals of being a good laptop. Lenovo takes a utilitarian approach to the design, complete with a ridged base to help

with heat dissipation, and it's a huge jump forward from the cheap plastic options you find across the Chromebook market. The aluminium construction is backed by testing to MIL-STD-810H standards, while a 1.2kg weight and slim chassis means I'd be more than happy to throw it into a backpack between meetings. The 5MP webcam is yet another plus, offering sharp images with great colours.

Nor does Lenovo compromise on the keyboard, with a tactile feel to the keys and a smooth touchpad with great multitouch controls. Lenovo also

offers an upgraded version with a touchscreen, but this adds to the price and isn't currently on sale in the UK.

You can perhaps see why this all came together to become a laptop I was genuinely happy using, contrary to my expectations. The downside is that, unlike so many Chromebooks, this isn't a cheap machine. As part of the deal, you're given access to the Google AI Pro Plan for 12 months. This suite normally costs £19 a month, and includes 1,000 monthly AI credits (compared to 100 for free), greater access to Gemini 2.5 Pro, access to NotebookLM's more advanced features, the use of Gemini across the entire Google suite (Docs, Gmail, Vids), access to the AI film-making tool Flow (including access to Google Veo 3), the Jules AI coding agent and 2TB of Drive storage. The downside is that you may get hooked and find it hard to go back to the free service.

My days of dunking on Chromebooks are over. The Lenovo Chromebook Plus Gen 10 isn't merely the best Chromebook I've used this year, but also one of the best laptops full stop. It's a carefully

thought through package, with a great design, ergonomics, a beautiful OLED display and sharp webcam, while Chrome OS has become an AI-fuelled system that can help you get things done. If your budget is £500 or thereabouts, this stamina monster is a fantastic buy. **JASON ENGLAND**

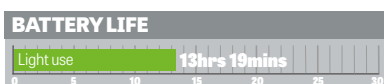
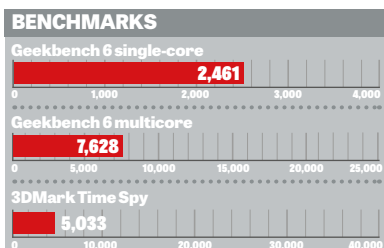
ABOVE The gorgeous 14in OLED screen makes watching TV and films a real joy



LEFT The aluminium casing is a step up from the plastic finish of most Chromebooks

"The Lenovo Chromebook Plus Gen 10 isn't merely the best Chromebook I've used this year, but also one of the best laptops full stop"

BELOW A ridged base helps dissipate heat from the powerful MediaTek processor



SPECIFICATIONS

8-core MediaTek Kompanio Ultra 910 • Immortalis-G925 MC11 graphics • MediaTek NPU 890 • 12GB LPDDR5X RAM • 14in 60Hz AMOLED non-touch panel, 1,920 x 1,200 resolution • 128GB eUFS 3.1 storage • Wi-Fi 7 • Bluetooth 5.4 • 5MP webcam • 2 x USB-C 3.2 Gen 1 • USB-A 3.2 Gen 1 • 3.5mm combo jack • 60Wh battery • Chrome OS • 314 x 219 x 15.8mm (WDH) • 1.2kg • 1yr RTB warranty • part code 83MY000FUK

Asus ExpertBook P3

Look past the drab screen and this business workhorse will satisfy for both speed and battery life

SCORE ★★★★★

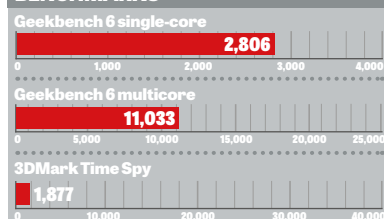
PRICE £667 (£800 inc VAT)
from [asus.com](https://www.asus.com)

Taiwanese manufacturer Asus is extremely keen to be the supplier of your business laptops, and its latest offering is the ExpertBook P3. Designed for volume purchase deals, this is a Copilot+ PC for the masses with a price to match. I can't be absolutely certain the ExpertBook P3 is the cheapest Copilot+ PC for business, but it's certainly not far off.

The star in the specification line-up is AMD's Ryzen 7 AI 7370. This is light years behind the power of the Ryzen 9 AI 395+ Max in the HP Z2 Mini G1a (see p60), but with four Zen 5 cores and four efficiency-focused Zen 5c cores it won't struggle with office tasks. It holds an advantage over Intel's Lunar Lake Core 7 258V in anything involving multiple threads, with 16 to call upon, and this was most evident in Cinebench 2024's multicore section – the Asus blasted to 808, while the Core 7 Ultra 258V-powered ThinkPad X1 2-in-1 (see p51) returned a miserly 450.

Intel's chip is the better choice if you need 3D acceleration: the integrated Radeon 860M graphics here could only return 20fps in *Shadow of the Tomb Raider* at 1080p High settings, while the ThinkPad X1 2-in-1 managed 35fps. Both systems naturally include a powerful NPU to meet Microsoft's Copilot+ PC certification.

BENCHMARKS



BATTERY LIFE



This is an all-metal chassis that has passed the MIL-STD-810H tests, and while it won't gain lustful glances from your fellow commuters – especially if you keep the Ryzen AI 7, Energy Star and HDMI stickers in place on the palmrest – it looks professional in gunmetal grey. Asus has attempted to add glitz to the large and responsive trackpad with a chrome edge, but it's fighting a losing battle.

It would have been wiser to add more cushioning to the squishy keyboard, which has a single-height Enter key and no obvious redeeming features. Aside from the backlight, perhaps, which offers three brightness levels and shines through the keys rather than around them – this makes the keyboard easy to use even in dark conditions.

Then we come to the most obvious sign of Asus' efforts to hit a budget, which is the 14in IPS non-touch display.

By recent laptop standards this is a drab offering, with 70% coverage of the already conservative sRGB gamut and a mere 40% of DCI-P3. With a peak brightness of 312cd/m² and an average Delta E of 4.77, the only positive words I can muster are that whites do actually look white.

I had to laugh when I tested the 1080p webcam. Its results are so poor that it's like travelling back in time to laptop webcams from 2015.

ABOVE Asus' ExpertBook P3 brings Copilot+ capabilities to the business world

"I can't be absolutely certain the ExpertBook P3 is the cheapest Copilot+ PC for business, but it's certainly not far off"

LEFT The squishy keyboard is at least easy to use in poor lighting

BELOW A plethora of ports includes RJ45, HDMI, two USB-C and two USB-A connectors

It's nothing to do with a lack of space, as it's built into the thick top bezel above the screen, which includes IR sensors for Windows Hello logins (there's also a fingerprint reader). The microphones are fine, but the next surprise was how good the speakers were: I was genuinely happy to listen to music on them.

Asus' approach to connectivity is also beyond reproach, with two USB-C ports on the left that sandwich an HDMI and USB-A port. There's a 3.5mm combo jack there, too. Head to the opposite side and you'll find a much-appreciated RJ45 connector and second USB-A port. Wi-Fi 7 and Bluetooth 5.4 complete the set.

Removing the bottom – a simple task of removing six crosshead screws – reveals a replaceable 70Wh battery that carried this laptop through almost 15 hours of light-use tasks. I doubt you'll need to bring the power supply with you on day trips, which is fortunate as this laptop isn't the lightest at 1.3kg. Or perhaps I've just grown too used to 1kg ultraportables.

Opening up this laptop revealed that the 32GB of memory is supplied on a single SODIMM, with one slot sitting empty. You can also replace the Wi-Fi card easily, likewise the 1TB SSD: this is a WD PC SN5000S drive that returned speedy 6,380MB/sec sequential reads in CrystalDiskMark 9 and 5,327MB/sec writes.

So this is a laptop of ups and downs. Great speed, strong battery life, solid build quality, brilliant connectivity and NPU smarts. But then a poor screen, awful webcam and mediocre keyboard. Whether its foibles can be forgiven ultimately boil down to price, with Asus assuring me the specification I tested would sell for £800 inc VAT (and its 16in brother for £1,000 inc VAT). I have to take that on trust, as its website suggests only volume deals are available – but if it really is that affordable, its positives outweigh its negatives. **TIM DANTON**

SPECIFICATIONS

8-core (4 x Zen 5, 4 x Zen 5c) AMD Ryzen AI 7 350 processor • AMD Radeon 860M graphics • 32GB DDR5-5600 RAM • 14in 60Hz IPS non-touchscreen, 1920 x 1200 resolution • 1TB M.2 PCIe Gen4 SSD • Wi-Fi 7 • Bluetooth 5.4 • 1080p IR webcam • 2 x USB-C 3.2 Gen 2 • 2 x USB-A 3.2 Gen 1 • HDMI 2.1 • 1GbE RJ45 • 3.5mm combo jack • 70Wh battery • Windows 11 Home • 313 x 227 x 18mm (WDH) • 1.3kg • 1yr RTB warranty • part code PM3406CK-R731X

Acer Aspire 16 AI (A16-11M)

A fine debut for the latest Snapdragon X chip in terms of speed and battery life, but don't expect frills

SCORE ★★★★★

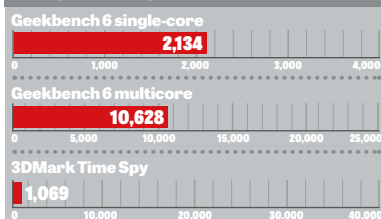
PRICE £833 (£999 inc VAT)
from [currys.co.uk](https://www.currys.co.uk)

One of the big complaints about Copilot+ PCs at their launch last year was that they were expensive. Microsoft's promise was that the asking price would soon drop to three figures and approach budget laptop territory, and that's precisely what has happened with the 2025 update to the Acer Aspire 16 AI.

Acer achieves this with a big helping hand from Qualcomm, which has introduced a new entry-level X series chip: the X1-26-100. The "26" in that name indicates roughly where it sits in Qualcomm's speed hierarchy, compared, say, to the "84" in the top-end X1E-84-100. But I think the company is underselling this chip's talents, because 2,134 in Geekbench 6's single-core test is a solid score, while its five-figure return in the multicore section matches the Core Ultra 7 258V in the ThinkPad X1 Carbon 2-in-1 (see issue 370, p52). Switch to the tougher Cinebench 2024 test and this £999 laptop far exceeds the £2,400 ThinkPad with a result of 701 versus 450.

3D acceleration is a different matter. This remains the great weakness of Snapdragon X chips, and its stripped-down GPU means the X1-26-100 performs at roughly half the speed of its more expensive

BENCHMARKS



BATTERY LIFE



Plus, I didn't mind the keyboard at all. The keys have all the travel of the Tube on strike day, but they're quiet, the backlight is extremely effective and Acer makes no compromises on key size or layout. That's despite including a number pad at the right. While the trackpad is similarly basic – no slinky glass coating here – it again wins for sheer size.

This generosity is reflected by a weight of 1.6kg, which means the Aspire 16 AI is far more at home on a desk than it is the sofa or rucksack, but it's slim and the battery life is phenomenal. We

siblings – a score of 1,069 in 3DMark Time Spy is woeful by modern standards, and even on the Lowest settings it stuttered to 23fps in *Shadow of the Tomb Raider* at 1080p.

Switch over to local AI and the new Snapdragon is just as fast as the NPU in Intel's far more expensive Lunar Lake chips. One of Qualcomm's biggest selling points is that all of its chips include the same NPU, so you'll benefit in the limited, albeit slowly growing, number of apps that take advantage. In the meantime

you can activate Recall, snigger at Cocreator and enjoy beautifully blurred backgrounds in web calls. Well, in theory: I saw an error message when I tried to activate these, but I suspect that's teething problems with the new chip. Even without blurring, quality from the 1440p camera is surprisingly good for such an affordable laptop.

The microphones also work well, but perhaps we should discreetly avoid mention of speaker quality. I made the mistake of switching from my Echo playing "Vamos" by Pixies to the screechy, tinny efforts produced by the Aspire 16 AI. Frank Black would not approve.

Nor has Acer splashed the cash on a luxurious panel, stretching 1,920 x 1,200 pixels across the 16in diagonal. A high contrast ratio of 2,050:1 and peak brightness of 405cd/m² are the only plus points, with mediocre 61% coverage of the sRGB gamut (44% of DCI-P3) and an average Delta E of 4.02. Still, pump up the brightness, choose a 150% scaling resolution and the sheer size of the screen makes everything easy to read.

ABOVE The Aspire 16 AI is a reasonably affordable Copilot+ PC

saw over 18 hours of video playback with the panel at 150cd/m², and it quickly charged back up to 45% after half an hour. Great results.

That life comes from a 65Wh battery that should be easy to replace when the time comes, once you fight past a tedious ten crosshead screws. The speakers are also replaceable – they, like most parts, are identified by QR codes – but the 16GB of RAM is embedded onto the CPU package. You can also replace the 1TB SSD, with Acer providing a handy guide to doing so in its "Lifecycle Extension Guide". This goes into depth on how to fix and replace other components, too, including the mainboard and LCD. Providing you can find replacements.

It's good to see such a big and fast SSD in an affordable laptop such as this, likewise Wi-Fi 7 and a generous dollop of ports, but I still think that £999 is too much to pay when you consider the low-quality panel and bottom-of-the-range processor. If I had to guess before I

had seen the price, I would have said £699 – and I recommend you hold on until it falls to such a point, as I suspect it will, before buying. **TIM DANTON**

LEFT The impressive keyboard has space for a number pad

"We saw over 18 hours of playback with the panel at 150cd/m², and it charged back up to 45% after half an hour. Great results"

SPECIFICATIONS

8-core Qualcomm Snapdragon X X1-26-100 processor • Qualcomm Adreno X1-45 graphics • 16GB LPDDR5X RAM • 16in 120Hz IPS non-touch display, 1,920 x 1,200 resolution • 1TB M.2 PCIe Gen4 SSD • Wi-Fi 7 • Bluetooth 5.3 • 1080p IR webcam • 2 x USB-C 4 • 2 x USB-A 3.2 Gen 1 • HDMI 2.1 • microSD card reader • 3.5mm combo jack • 65Wh battery • Windows 11 Home • 356 x 250 x 16mm (WDH) • 1.6kg • 1yr RTB warranty • part code NX.JLNEK.006

BELOW A generous selection of ports adds to the laptop's appeal





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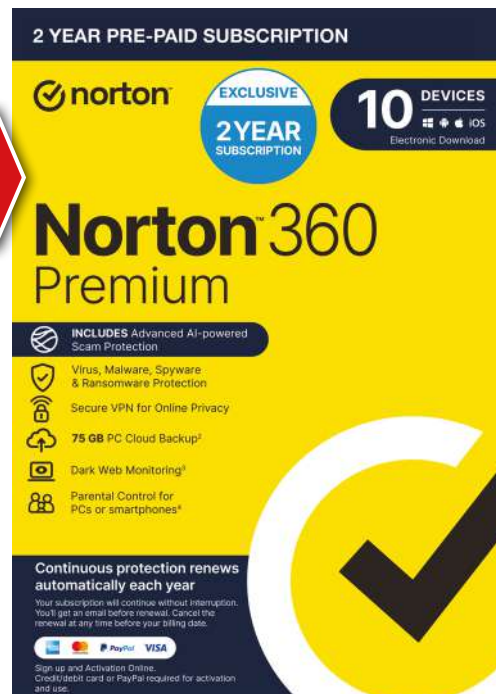
Because it's the Premium version of Norton 360, you get a host of extra tools. Top of the list is the full version of Norton VPN, both to protect your identity and provide a way of watching British TV while you're abroad.

There's also 75GB of cloud storage for secure backup, while Norton's Dark Web Monitoring service will alert you if private details – such as your email address and passwords – have been compromised online.

Norton Parental Control provides tools to see exactly what your kids are up to on their various devices, allowing you to set browsing times and restrictions, and you also get GPS location monitoring for Android and iOS.

To round things off, Norton Password Manager generates and stores passwords across all your devices. All this for £19.99? Did someone say bargain?

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1 PC PERPETUAL LICENCE

■ tinyurl.com/win11pro-upgrade

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Note that the upgrade only works from an activated copy of Windows 11 Home, so if you're using Windows 10 Home then you'll need to upgrade to Windows 11 first. Want to upgrade from Windows 7 or 8? Or building a PC from scratch? Head to tinyurl.com/windowspro11 and grab a full 1-PC licence for Windows 11 Pro for only £79.99.



LAPLINK PCMOVER PROFESSIONAL 11 from £34.95

1 MIGRATION £34.95

3 MIGRATIONS £49.95

■ tinyurl.com/laplinkpcpro

Laplink PCmover Express is a brilliant way to migrate your PC to Windows 11, but the one thing it can't move is your applications. For that, you need Laplink PCmover Professional 11, and we're offering a single-migration licence for £34.95, a 30% saving, or a licence for migrating three PCs for £49.95. That's half price!

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If you're moving from one PC to another, then as long as you can connect the two – either directly or on the same network – PCmover Professional can transfer your data at super-high speed. Can't connect the PCs? The program can also save the data from your old system to a file, for instance on an external drive.

If you run into any problems, your licence includes free support from Laplink via a dedicated freephone number in the UK.



Lenovo Yoga AIO 27i Gen 10 (Intel)

A sturdy 27in all-in-one with a high-quality display and strong performance, but it lacks finesse and luxuries

SCORE ★★★★★

PRICE As reviewed, £1,058 £1,270 inc VAT from lenovo.com

If you're the kind of person who likes a neat desktop, Lenovo's latest Yoga AIO 27i is for you. It offers a smart design with solid performance, and comes with everything you need either built in or included in the box. I spent a week using this all-in-one PC as my main desktop for work and creative projects, and while there are a few areas where it could be improved, the experience was almost entirely positive.

It's a sturdy and elegant-looking device, with plenty of practical features. The stand stays rock-solid during adjustments, letting me tilt, raise, lower or rotate the display with ease – although I do wish the screen could sit a bit lower for shorter users.

As an added perk, the stand doubles as a wireless phone charger. I love being able to pop my phone on the base while working and never worry about running out of juice for the rest of the day. I also appreciate that the power button and OSD joystick sit conveniently on the stand's left side, so I didn't have to fumble around trying to find controls when making screen adjustments or powering the device on.

As with most AIOs, the mouse and keyboard are included, and the main display unit features integrated speakers and a webcam. There's nothing to assemble or set up, beyond plugging in the mouse and

keyboard and connecting the whole thing to the mains.

If you need to connect additional accessories, there's an easily accessible set of ports at the rear and sides.

The configuration I reviewed features an Intel Core Ultra 7 255H processor, with Arc 140T graphics, 16GB RAM and a 1TB SSD. That's plenty of power for smooth performance in creative or workday tasks. I used the Yoga AIO 27i to work on digital drawings, edit photos, write articles, attend video meetings and stream TV shows, and it handled all of these tasks with aplomb. However, if you want to play immersive 3D games you might prefer something like the Yoga AIO 9i (see issue 373, p63), which comes with a discrete Nvidia RTX 40-Series GPU: the Arc graphics

in this model are best suited to casual desktop gaming.

The IPS display is by no means the prettiest screen I've used, but it's not bad. I measured it as covering 98% of the sRGB gamut and 77% of DCI-P3, so it's not suitable for serious visual

professionals but fine for most other purposes. At maximum brightness, the screen reaches just shy of 400cd/m²; contrast is admirable and everything looks solid, even if the overall impression isn't as bold as you'd get with an OLED display. The built-in JBL speakers deliver crisp audio with enough punch for everyday music and streaming; tucked neatly behind the monitor, they get the job done without fuss.

Another thing I love is that the display rotates between landscape and portrait – presumably that's the Yoga part – and Windows

automatically reorients the desktop to suit, so there are no manual tweaks needed. The only bit of integration that's missing is touch; this panel won't respond to taps and swipes.

The keyboard, meanwhile, is one of the most satisfying I've ever used. Its floating keycaps look fancy, while the keys themselves press in beautifully while you type. It's also rechargeable via the included USB cable,

so you don't have to hunt down AA batteries every few months. The biggest problem is that my cats' fur got stuck under the keys and proved hard to fish out. The wireless mouse is less special – it isn't going to win any beauty contests – but it works reliably.

One thing I'm not so sold on is the integrated webcam. While the microphone proved crystal clear in my online meetings, the webcam's image was washed out and grainy at first. Software tweaks improved the colour and sharpness, but the graininess stuck around no matter what I did. It does, however, work perfectly with Windows Hello, allowing me to log in with a smile.

Those who value privacy should note that there's no physical camera shutter – just an e-shutter switch located on the stand.

Overall, this is a solid all-in-one PC that's perfect for everything from daily work to video streaming. It would be

even better if the adjustable stand came down a little lower, and also if the webcam weren't quite so grainy, and it's not ideal for graphically demanding programs or games. However, I've enjoyed my time with the Lenovo Yoga AIO 27i, and can easily recommend it to anyone wanting a simple, reliable desktop for work, school or creative projects.

REBECCA SPEAR

SPECIFICATIONS

16-core (6 P-cores, 8 E-cores, 2 LPE-cores) Intel Core Ultra 7 255H processor • Intel Arc 140T graphics • 16GB LPDDR5X-7467 RAM • 27in 120Hz IPS non-touch panel, 2,560 x 1,440 resolution • 1TB M.2 PCIe Gen4 SSD • Wi-Fi 7 • Bluetooth 5.4 • 5MP IR webcam • 2 x USB-C 3.2 Gen 2 • 3 x USB-A 3.2 Gen 2 • HDMI 2.1 output • HDMI 2.1 input • 1GbE RJ45 • 3.5mm combo jack • 2 x 5W speakers • wireless charger • wireless keyboard and wired mouse • Windows 11 Home • 614 x 235 x 566mm (WDH) • 8.4kg • 1yr C&R warranty

ABOVE The sturdy, elegant Yoga AIO has everything you need in one package

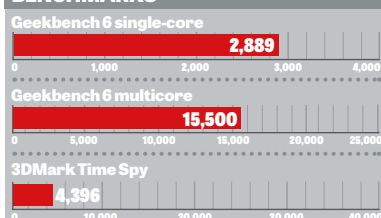


"The keyboard is one of the most satisfying I've ever used. Its floating keycaps look fancy, while the keys press in beautifully"

LEFT You can tilt, raise, lower and rotate the display easily

BELOW It's easy to access the ports on the side of the stand

BENCHMARKS





HP Z2 Mini G1a workstation



This AI-focused workstation could make a drastic difference to the speed of your workflows

SCORE ★★★★★

PRICE As reviewed, £2,280 (£2,736 inc VAT) from hp.com

If you ever wanted evidence that the shape of computing is changing, you need only look at our mini PCs Labs from p78 and the HP Z2 Mini G1a workstation on test here. These bijou systems pack the sort of power previously reserved for hunking tower PCs: modern processors are that good.

In the HP Z2 Mini's case, the processor is AMD's Ryzen AI Max+ Pro 395. AMD calls this Strix Halo, and it's a chip that Intel currently has no answer to. A total of 16 powerful Zen 5 cores sit at its centre, but it's the Radeon 8060S graphics and 50 TOPS

NPU that earn the Z2 Mini G1a the description of "AI workstation". Plus the ability to siphon off up to 96GB of the system RAM to the GPU, but we'll come to that in a moment.

So far, only a handful of systems feature the Ryzen AI Max+ Pro 395. We review one such PC, the Framework Desktop, over the page, while the Geekom A9 Mega features in our IFA coverage (see p32). A handful of laptops have also packed the chip, but these will never provide the same level of cooling as a mini PC.

Not that the HP Z2 Mini G1a is a power hog: it sips around 10W when idling along and stayed below 250W even at full pelt. On a full-size workstation, those figures would be closer to 80W and 800W respectively.

■ The HP difference

No surprise, then, that the HP Z2 Mini G1a sits quietly when running undemanding tasks in Windows, with the fan only jumping into action when the CPU or GPU are pushed.

This didn't slow the PC down in the CPU-focused Cinebench 2024 test, where it scored 1,826 in the multicore

ABOVE The distinctive grille looks great and is integral to this workstation's cooling



ABOVE These frequently used ports sit on the side rather than the rear

section – a fraction ahead of the 1,804 from the Framework Desktop. Those positions reversed in Geekbench 6, with the Z2 Mini scoring 2,780 in the single-core test and 16,720 in the multicore section compared to 2,966 and 17,574 for its rival.

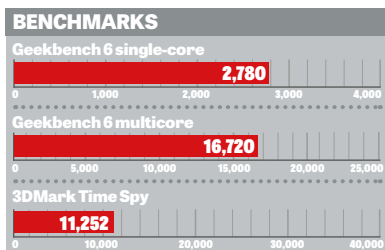
Framework's mini PC again held a slight advantage in 3DMark Time Spy, but once I switched to actual games the HP stretched ahead. At 1080p and our usual tough settings for desktop PCs, it returned 92fps in *Shadow of the Tomb Raider*, 106fps in *Dirt 5* and 115fps in *Borderlands 3*. That compares to 87fps, 85fps and 103fps for its Strix Halo-powered rival.

I should pause here to point out what exceptional scores those are for an integrated GPU, roughly equivalent to a desktop RTX 5050.

■ AI workstation

But it's the mix of powerful CPU, GPU and NPU that qualifies this mini PC for the "workstation" description. It's now

"These bijou systems pack the sort of power previously reserved for hunking tower PCs: modern processors are that good"



possible to run a Llama 4 Scout LLM directly on this system with 128 billion parameters. To put that into context, ChatGPT-3 had 175 billion parameters. It means this tiny system can create realistic images from text at terrific speeds, where previously you would have required a heavyweight graphics card to achieve similar results.

This is all possible because you can instruct the Z2 Mini G1a to assign 96GB of its 128GB unified RAM to the GPU. Large language models thrive on large amounts of video RAM because as soon as they need to call upon system RAM their output drops. One excellent metaphor (tinyurl.com/374vram) describes parameters as the ingredients required by the chef, VRAM the chef's countertop and regular RAM the pantry that the chef needs to dash to find more ingredients.

The experts at AMD assure me that in the future they will have a system where you can reallocate unified RAM within Windows, but for now it's all done via the BIOS. A pain, but if you want to run LLMs locally then the rewards are obvious.

■ Regular workstation

To see how the HP Z2 Mini G1a performed as a creative workstation, I downloaded SPECviewperf 15 and compared the results to full-size workstations in our recent group test (see issue 373, p76). It would be unfair to compare £10,000 exc VAT systems with their RTX 6000 Pro graphics cards that cost almost £6,500 exc VAT on their own, but Workstation Specialists' WS AR-X3700 is fairer game at £2,978 exc VAT. It combines a Ryzen 9 9950X with an Nvidia RTX 4000 Ada Generation card, with 64GB of system RAM.

Fairer game, but not entirely fair, it turns out. In the 3ds Max 2023 workloads, using DirectX 11, it averaged 26 frames per second compared to 64fps for the AR-X3700. In Blender workloads, 25fps versus 53fps. It was a similar story in the Catia, Creo and Maya viewsets, with HP's 30fps, 68fps and 50fps some distance behind the fully grown workstation's 87fps, 195fps and 191fps.

The Z2 Mini's most competitive result actually came in the medical-04 workload, which (to quote) "evaluates medical visualisation techniques using the Tuvok library and OpenGL API". Here, it achieved 84fps against 142fps for the AR-X3700 and was a mere 10-15fps behind the workstations toting GeForce RTX 5090 graphics cards.

So this mini workstation isn't a true rival to workstations with pro-level graphics cards, but considering its size – and its price – it



provides a respectable amount of rendering and visualisation power.

■ Room to grow

HP has taken the interesting decision to integrate the Z2 mini's power supply into the body of the unit, which is the more difficult option: PSUs generate heat and take up space, which is why most mini PCs come with an external unit. But this decision makes it easier to manage, with HP claiming that five units can sit across a 4U rack. There are also four VESA-compatible mounting points hiding under the rubber strips that prevent this PC sliding around on your desk; with an optional VESA mounting kit, you could tuck the PC discreetly behind a monitor.

I wouldn't bother, because it robs you of easy access to the numerous ports on the rear. It's crowded, but you'll find two mini-DisplayPort ports (two adapters to turn these into full-size DisplayPort connectors are in the box), two USB-C 4 ports, four USB-A connectors and a 2.5GbE connector. A USB-C 3.2 Gen 2 port, 3.5mm combo jack and USB-A 3.2 Gen 2 port sit on the side. HP also provides two slots for its FlexIO add-on cards if you want more connectivity – for example, a full-size DisplayPort or 10GbE networking.

There's also room to grow inside, with two M.2 slots available for storage. HP claims that you can take storage capacity up to 8TB via a pair of 4TB drives, but that option isn't available from the UK website, which is restricted to 512GB, 1TB, 2TB or a pair of 1TB

ABOVE There is 3D modelling power here, but don't expect it to rival £4,000 creative workstations

"HP has put a lot of thought into the design of this workstation, and it's a fantastic advert for the Ryzen 9 AI 395+ processor"

BELOW HP crams in the ports, not to mention building in the power supply



drives. The price here includes a single 2TB HP Z Turbo Drive, a PCIe Gen 4 SSD, which returned strong sequential transfer rates of 7,075MB/sec reads and 6,025MB/sec writes in the CrystalDiskMark 9 benchmark.

■ Final thoughts

HP has put a lot of thought into the design of this workstation, and

it's a fantastic advert for the Ryzen 9 AI 395+ processor. Does all this quality come cheap? Absolutely not, but due to that single trick of dedicating up to 96GB of unified memory to the GPU it becomes more versatile than far more expensive creative workstations. The fact you can run such a sophisticated LLM on a computer this small is simply astonishing.

But the Z2 Mini G1a doesn't live in a vacuum. You can buy the Framework Desktop with a very similar specification for around £2,000 inc VAT, while the Geekom A9 Mega is available on Kickstarter for \$1,899. Where HP

wins is for speed of delivery – within two working days compared to "Q4" for the Framework and December for the A9 Mega – plus reassurance. This computer comes with a one-year warranty as standard, but you can extend this to three years of on-site cover for around £45 exc VAT at the time of purchase. HP also shows its environmental credentials through its use of recycled materials and EPEAT Gold Climate+ certification.

Most of all, it's a phenomenal piece of engineering that will look great on a desk. If you're an AI developer, 3D designer or gamer – or possibly a combination of all three – then this mini workstation deserves a place on your shortlist. **TIM DANTON**

SPECIFICATIONS

16-core/32-thread AMD Ryzen AI Max+ Pro 395 processor • 128GB unified LPDDR5x-8533 RAM • integrated AMD Radeon 8060S graphics • 2TB HP Z Turbo Drive PCIe Gen 4 SSD • Wi-Fi 7 • Bluetooth 5.4 • 2 x mini DisplayPort 2.1 • 2 x Thunderbolt 4/USB-C 4 • USB-C 3.2 Gen 2 • 3 x USB-A 3.2 Gen 2 • 2 x USB-A 2 • 3.5mm combo jack • 2 x FlexIO ports • 2.5GbE • 400W PSU • Windows 11 Pro • 85 x 168 x 200mm (WDH) • 2.3kg • 1yr RTB warranty • power: 10W idle, 244W peak



Framework Desktop

The compact Framework Desktop is both fast and charming, but you're paying over the odds

SCORE ★★★★★

PRICE As reviewed, £1,599 (£1,919 inc VAT) from [framework.work](https://www.framework.work)

Framework builds its laptops with the ethos of a desktop: repairable, customisable and even upgradable when new parts come out. Now, the company's offering a desktop too.

Surprisingly, though, the Framework Desktop seems to embody an opposite ethos to the laptop, being more of an integrated unit than a regular system. It comes with both the CPU and RAM soldered to the motherboard, meaning the only user-upgradable elements are storage, Wi-Fi, the case fan and a few decorative and connectivity components at the front.

You get numerous configuration options at the point of ordering. The base system costs £1,099 inc VAT and comes with an AMD Ryzen AI Max 385 processor, Radeon 8050S graphics and 32GB of RAM. We tested the £1,599 mid-range model, which uses the more powerful AI Max+ 395 processor with Radeon 8060S graphics, and comes with a more generous 64GB of RAM. The top-tier option costs £1,999, incorporating the same processor but a whopping 128GB of memory.

Those prices are undeniably on the high side – and what's more, they only cover the basic system, with no SSD or operating system. You can supply both of these yourself if you like, but our review unit came with a 1TB WD Black SN7100 SSD, adding an extra £99 to the price. Framework can provide a copy of Windows 11 Home too, but it will charge you the full



£120 RRP, so we suggest you save money by buying from the *PC Pro* store (store.pcpro.co.uk) for £60.

There are a few other components you'll need to complete the system. Framework supplied a Cooler Master Mobius 120 CPU fan (costing an extra £19), a power cable (£5) and a couple of USB Type-A and Type-C expansion cards (£9 each) that slot into the front of the chassis to provide forward connectivity. Add that all up and you're looking at £1,878. There are a few other options to choose from, such as an RGB fan and a translucent side window to see it through.

Finally, you'll probably want to buy some tiles for the front panel. These are purely cosmetic, but if you don't buy them your computer will have big gaps in its chassis. They come in a variety of colours and patterns, costing either £10 or £15 for a pack of seven (you need 21 to fully cover the front). You can also buy individual tiles with logos for AMD and a number of Linux distros for a fiver each. I do feel that a set of blanks ought to be included in the standard price, as should a power cable. Enthusiasts may have extras, but this isn't like a phone, where everyone has spares lying around their house.

Cute design

When you take the Framework Desktop out of its box, the first thing that strikes you is how small it is. It



ABOVE The PC can be customised with your choice of tiles for the front of the chassis

“The Framework Desktop has two slots allowing you to swap in and out whichever connectors you choose”

LEFT The system is powerful enough both for productivity tasks and gaming

BELOW Assembling the Framework Desktop is a quick and simple process

comes in a plain black 4.5-litre mini-ITX case that will fit on even the smallest desks. The side panels are plastic with some metal shielding inside, while the top is entirely plastic.

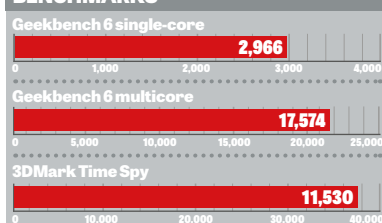
Although Framework refers to this as a “DIY” computer, it arrives with the motherboard already in place, a sizeable heatsink sitting on top of the CPU and a 400-watt FlexATX power supply preinstalled and connected. All you need to do is remove the side and top panels, install your SSD and fan and boom – complete system. The process took me less than 20 minutes using the screwdriver that's helpfully included in the box, and if you're not sure what you're doing there's a step-by-step guide on the Framework website. The hardest part is plugging in the fan header on the motherboard (and the RGB header if you've chosen a light-up fan unit), which requires nimble fingers.

Clearly, there's not much scope for further expansion, but if you open the right side of the chassis you'll see a second M.2 slot on the back of the motherboard, as well as access to the AMD RZ717 Wi-Fi 7 card, which comes as standard and which you could in theory upgrade at some point in the future. That's about it: there's room to install an additional 92mm fan at the front, along with a second fan header to connect it to the motherboard, but Framework says that's unnecessary as the main system fan will suffice on its own.

The most versatile part of the design is the ports at the front of the case. The Framework Desktop uses the same pick-your-port expansion card system as Framework's laptops, with two slots allowing you to swap in and out whichever connectors you choose. Options include USB, a headphone socket, SD card slots, 2.5Gbits/sec Ethernet and additional storage. You might find it annoying that you can only have two cards installed at once, as the space could have accommodated three or four



BENCHMARKS



native sockets, but there are plenty more connectors at the rear, namely twin USB 3.2 Gen 2 Type-A ports, a pair of USB4 ports, HDMI, dual DisplayPort outputs, 5Gbits/sec Ethernet and a headphone jack.

The front of the system also offers a magnetic frame to hold those coloured or patterned tiles we mentioned earlier. This is Framework's way of letting you personalise the system, reflecting the company's maker roots.

■ Kitted out to the Max+

While the AMD Ryzen AI Max+ 395 is designed for mobile and small-form-factor roles, it can hold its own against traditional desktops when it comes to productivity. In Geekbench 6, the Framework Desktop notched up a single-core score of 2,966 and a multicore score of 17,574, putting it in the same broad ballpark as high-end productivity machines using CPUs such as the AMD Ryzen 9 9955HX or the Intel Core Ultra 9 275HX.

If you want to compare it to a small-form-factor rival, one obvious alternative is the Mac mini. A 12-core M4 Pro system (we still await test samples of the M5 Mac mini) with 1TB of storage and 64GB of RAM raced ahead of the Framework Desktop in the Geekbench tests, with scores of 3,880 and 22,661. However, in our video-encoding test the Framework managed to transcode a 4K video to 1080p in 2mins 43secs, while the Mac mini was four seconds slower.

Be aware that if you want more performance, you can't overclock this chip, at least not with current firmware. Framework's BIOS doesn't offer any options for it, and the Ryzen Master app throws up an error stating that the processor isn't supported and that the software can't be installed.

As for file transfers, that will depend entirely on which SSD you choose. With our 1TB WD Black SN7100, a Gen 4 rather than Gen 5 disk, we saw the system blaze through our real-world test at a rate of 2,976MB/sec, surpassing the Mac mini at 2,237MB/sec.

■ Gaming skills

Clearly the Framework Desktop is a powerful productivity system, but the integrated GPU is no lightweight either. Often referred to by its "Strix Halo" codename, the Radeon Strix 8060S features 40 compute units, and while it doesn't measure up to dedicated gaming desktops with hefty graphics cards, there's definitely enough power here for gaming. It doesn't hurt that it shares the system's RAM with the CPU, giving it plenty of headroom here.

To confirm its performance, I tried playing *Alan Wake 2* on the Medium

graphics preset, with no ray tracing, FSR enabled and a 720p render upscaled to 1080p. The results were impressive, with the titular hero exploring a nightmare New York at more than 70 frames per second. The game even remained playable when I switched to High settings, though it dropped below 60fps.

In *Shadow of the Tomb Raider*, the Framework Desktop averaged 87fps on the highest settings at 1080p, and it excelled at CPU-heavy games such as *Far Cry 6* at Ultra settings (83fps) and *Borderlands 3* on the "badass" preset (103fps.) The game even performed passably on *Red Dead Redemption 2* at medium settings (57fps), faltering only on *Cyberpunk 2077*'s challenging Ray Tracing Ultra preset (22fps).

■ Desktop dissonance

During my time with the Framework Desktop, I have to admit I've felt a sense of dissonance. I've always enjoyed tinkering with Framework



laptops, but the Desktop gives me much less to play with. Framework says there's a good reason for using an integrated CPU and RAM: it's the only way to achieve the memory bandwidth and performance it was going for. "Because the memory is non-upgradable, we're being deliberate in making memory pricing more reasonable than you might find with other brands," the company has suggested in a blog post – although the system as a whole is hardly a value proposition.

Of course, if you want replaceable memory, there are hundreds of other PCs that still give you the option, or you can always build your own. I've come to terms with it by trying not to think of the system as a desktop with limitations, but



ABOVE You can buy individual tiles with logos for AMD and a range of Linux distros

"It's perfect for productivity, and graphical performance is admirably strong for a system without a discrete GPU"

rather as a more upgradable alternative to a Mac mini.

And there is one part that feels very Framework. While the system is sold almost complete, you can also buy individual components – including the mainboard and case – separately.

This allows for some interesting projects; for example, Framework has suggested using multiple boards as LLM racks for big AI projects.

■ Bottom line

The Framework Desktop offers a lot of power for a small system. It's perfect for productivity, and graphical performance is admirably strong for a system without a discrete GPU. Although it doesn't feel like a Framework product in the way I'd hoped, I've enjoyed using

the system during my time with it: it's versatile, powerful and dare I say cute.

The real issue is price. For the basic cost of the entry-level system – even before you add in the missing components and operating system – you can buy a decent gaming PC with a middleweight graphics card. For the cost of our fully configured system you can buy something very nice indeed. If you care at all about GPU performance, a traditional desktop makes more sense, and will be more customisable down the line, too.

Still, the Framework is a charming choice for general-purpose desktop roles that need a decent amount of RAM. In particular, there's a reason that Framework pitches it for running AI models – that's the role it makes the most sense for. Factor in the cute chassis and the fun of putting parts of the system together yourself and I can see some people falling for the Framework Desktop. For most of us, though, either a stronger gaming rig or a cheaper productivity system will do the job – and it will come with everything you need out of the box. **ANDREW E FREEDMAN**

ABOVE Putting the components together adds to the PC's appeal

BELOW Both the RAM and CPU are soldered on to the motherboard



SPECIFICATIONS

16-core/32-thread AMD Ryzen AI Max+ 395 processor • Framework FRAMMFCPO4 motherboard • 64GB embedded LPDDR5-8000 RAM • integrated AMD Radeon 8060S graphics • Cooler Master Mobius 120 CPU air cooler • 1TB WD Black SN7100 M.2 PCIe Gen 4 SSD • Wi-Fi 7 • Framework Desktop chassis • 400W FlexATX PSU • Windows 11 Home • 97 x 206 x 226mm (WDH) • 2yr limited warranty • power: not tested



Medion Erazer Bandit P20

A fantastic-value midi tower PC with decent gaming skills but not a huge amount of room to grow

SCORE ★★★★★

PRICE £833 (£1,000 inc VAT) from laptopsdirect.co.uk

Is it unfair to compare Medion to Lidl? I'm not sure how happy the German PC manufacturer would be with this comparison, but there's surely no disputing both companies' emphasis on delivering high-value products in a pile 'em high style. This is particularly true for Medion's budget lines, and the Erazer Bandit P20 certainly qualifies for that description when you consider what it packs in for £1,000.

The centrepiece is an Nvidia RTX 5060 graphics card, which dominates the inside of the compact chassis. One spare PCIe x1 slot sits below this, but you'll have to remove the GPU, which almost stretches the width of the case, before you can access it. It's equally fiddly to reach the empty M.2 slot: this sits under the supplied SSD and is sandwiched between the graphics card and the air cooler sitting atop the Intel Core i5-14400 processor. In fact, the only upgrade that's easy to make directly on the motherboard is to the RAM, with two DDR5 sockets sitting empty.

By contrast, I love the simplicity of Medion's chassis. Whether you want to remove the tempered glass side or the metal one, you need only insert your finger into the gap and pull. It's equally easy to put them back in place, and they sit securely once there. Thanks to sensible cabling, you will find it easy to add a 3.5in hard disk and up to three 2.5in SATA drives too. And this chassis is so small you

should be able to find a place for it on your desk or tucked away underneath.

Unlike the other PCs I review this month – the CyberPowerPC Ultra R5XT opposite and the HP Z2 Mini G1a on p60 – there's always a hum from the fans here. Not to an annoying extent, as it blends into the background and never raises in volume even when pushed, but this isn't a PC for those who cherish silence.

Nor for those who love addressable RGB; while the five fans keep their colours in sync, they aren't controllable via Erazer's software nor detectable by third-party software such as OpenRGB. That means you have a rotating set of lights whether you like it or not, including through the antler cutout on the front. This could be a pain if you're downloading something overnight and need to keep the PC switched on.

Erazer keeps things simple in terms of connections. Two USB-A ports, a 3.5mm jack and a USB-C port all sit on the top (they aren't labelled but they all support 5Gbps/sec transfers), with the rear offering two USB-A 2 ports, a 10Gbps/sec USB-C 3.2 Gen 2 port, 1GbE RJ45 and two further USB-A 3.2 Gen 1 ports. There are also aerial connectors for the Wi-Fi 6E controller built into the Medion B760H7-EM motherboard, a mic in, line in and line out.

A 650W power supply keeps things ticking, and with peak consumption of 278W there's room to upgrade the graphics card. Not that you should need to, as the combination of an 8GB

ABOVE The Erazer Bandit P20 is terrific value for a gaming PC

LEFT Two USB-A ports, a 3.5mm jack and a USB-C port sit on the top of the chassis

"The combination of an 8GB RTX 5060 card and Intel Core i5-1440 CPU are plenty for comfortable 1440p gaming at most settings"

BELOW The fans keep their colours in sync, but can't be controlled by software

RTX 5060 card and Intel Core i5-1440 CPU are plenty for comfortable 1440p gaming at most settings.

How comfortable? As mentioned in the CyberPowerPC review opposite, the RTX 5060 falls a few percentage points behind the AMD Radeon RX 9060 XT in general, but the Bandit P20 rarely fell below 60fps in *Dirt 5*, *Shadow of the Tomb Raider*, *Metro Exodus: Enhanced* or *Borderlands 3* at 1440p with high settings, and averaged between 80fps and 100fps.

Ray tracing presents more of a challenge. *Cyberpunk 2077* with RT Ultra presets (but no DLSS) saw a terrible 16fps return, but activating DLSS pushed that to 56fps. When I switched on Nvidia's Frame Generation (2x, Quality) it jumped up to a smooth 89fps. The other limitation is 8GB of video memory, which won't be enough for the toughest detail settings in more demanding AAA games.

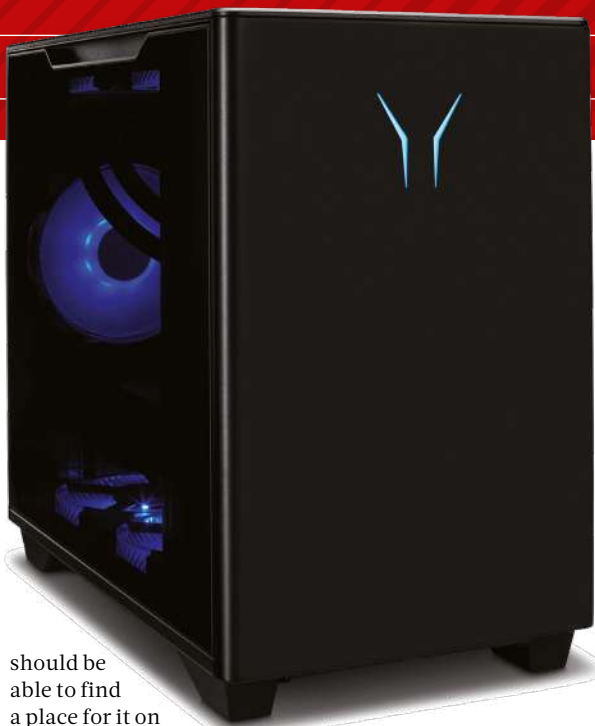
So, with those caveats applied, gaming at 1440p is a tick. Day-to-day duties likewise, as Intel's Core i5-14400 is a solid processor with six fast P-cores and four E-cores for a total of 16 threads. That showed itself as a respectable 11,321 in the Geekbench 6 multicore test and 704 in Cinebench 2024. Both scores were a long distance behind the Ryzen 7 9700X in the CyberPowerPC, though, so if you frequently edit videos or

crunch databases then the choice is obvious. Medion also goes mid-range for its choice of Gen 4 SSD, with sequential reads and writes hovering around the 5,000MB/sec point in CrystalDiskMark.

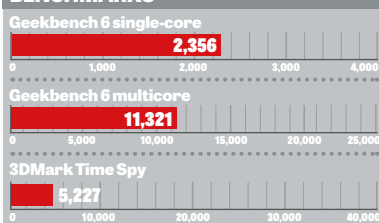
The final thing to bear in mind is the warranty. Every Medion PC comes with two years of cover, and that includes courier costs, parts and labour. Medion also promises free, UK-based technical support for life. The only thing it lacks is a proven track record via the PC Pro Technology Excellence Awards, as not enough of our readers have bought its PCs to give us statistically solid results. Perhaps that will change next year, because the Erazer Bandit P20 really does offer terrific value for money. **TIM DANTON**

SPECIFICATIONS

10-core (6 P-cores, 4 E-cores) Intel Core i5-14400 processor • Medion B760H7-EM motherboard • 16GB unbranded DDR5-5600 RAM • 8GB Nvidia GeForce RTX 5060 graphics • unbranded RGB air cooler • 1TB WD Blue SN5000 PCIe Gen 4 SSD • Intel AX201 Wi-Fi 6 • Erazer Bandit P20 chassis • 650W InWin PSU • Windows 11 Home • 215 x 401 x 347mm (WDH) • 2yr C&R warranty • power: 38W idle, 278W peak



BENCHMARKS



CyberPowerPC Ultra R5XT Gaming PC

A quiet-running system powered by an excellent all-round CPU and AMD's potent RX 9060 XT graphics

SCORE ★★★★★

PRICE £1,124 (£1,349 inc VAT) from cyberpowersystem.co.uk

When buying a PC, there's always a sweet spot when it comes to value. Right now, that spreads from around £800 to £1,500; the Goldilocks zone where every pound you spend has a notable impact on power, design and features.

Here, CyberPowerPC's biggest investment is in the AMD graphics card, which might be a surprise inclusion to some. For years, Nvidia's RTX range has dominated the graphics card market, but this year marks a shift.

Nvidia's RTX 50 series still wins at the high end, but by focusing on AI enhancements rather than raw performance it allowed AMD to catch up via its RX 9000 series cards. The RX 9060 XT with its 16GB of VRAM is a fine choice as it provides consistently strong speeds across a range of games at 1440p, including titles that support ray tracing.

Take *Cyberpunk 2077*. In the game's RT Ultra setting, the R5XT averaged 77fps compared to 71fps for the Medion Erazer Bandit P20 opposite with its RTX 5060. Likewise in *Metro Exodus: Enhanced*, with the R5XT averaging 70fps at Ultra settings to 64fps from its rival.

Switch to games without ray tracing and the gap is small but consistent: 82fps in *Shadow of the Tomb Raider* at Highest graphics settings and SMAA4x anti-aliasing compared to 80fps; 108fps versus



99fps in *Dirt 5* at 1440p Ultra settings; 89fps at 1440p Badass in *Borderlands 3* to its rival's 82fps (all these results are at 1440p). Yes, Nvidia's Frame

Generation technology can boost frame rates even higher in supported games, but if you prefer to avoid such AI shenanigans then AMD has this battle won.

It helps that CyberPowerPC UK – based in Gateshead – chose AMD's Ryzen 7 9700X processor to complement the graphics card. This is one of the fastest desktop chips around in both single-core and multicore tasks, as shown by its 3,349 and 16,289 returns in Geekbench 6. It's no slouch in Cinebench 2024 either, with 136/1,105 in its single-core/multicore sections; that compares to 100/704 for the Core i5-14400 in the Medion Bandit.

I was hoping to see a Gen 5 SSD in this PC as one of the motherboard's two M.2 slots supports it, but CyberPowerPC instead opts for size via a 2TB Kingston NV3 Gen 4 SSD: its sequential reads and writes of around 6,000MB/sec are exactly as expected. However, one of CyberPowerPC's big advantages compared to the Medion Bandit P20 is that you can easily change this to a Gen 5 SSD at the time of ordering; doing so

ABOVE There's plenty of room for expansion, and it's easy to work inside, too

LEFT AMD's Radeon RX 9060 XT graphics make a welcome change in a gaming PC

"The RX 9060 XT with its 16GB of VRAM is a fine choice as it provides consistently strong speeds across a range of games at 1440p"

BELOW The sweeping design of the window adds to this PC's style

adds around £100 to the price. Space is also available for two 2.5in SATA SSDs if you remove the right-hand side of the striking chassis.

Its impact is largely due to the swing-door style window. This stretches round to the front, and opens to give you unfettered access to the PC's innards. Here you can admire the three RGB fans, the detail of RGB lighting where the bottom of the window meets the chassis, and the colourful aRGB heatsinks of the Kingston Fury Renegade RAM (two empty slots sit ready if 32GB proves insufficient). On a minor note, you may want to remove the stickers from the RGB fans as our three were ever so slightly off-centre, meaning they wobbled while whirring.

More importantly, this is a quiet-running system that will rarely bother you even if it sits on your desk, and with peak power consumption of 330W there's plenty of headroom from the 750W Corsair PSU.

So to the big question: is it worth paying another £349 for this PC over the Medion? In terms of power-per-pound, it's questionable. While the CyberPowerPC is faster in every category, and by some distance in tasks that utilise multiple threads, this

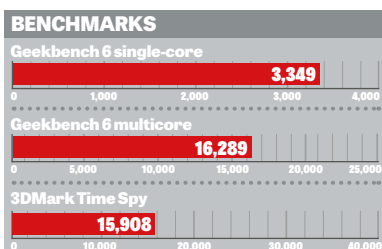
isn't something most people will notice every day. Nor is there a huge gulf between the two when gaming.

However, there are several factors in CyberPowerPC's favour.

You get a five-year warranty, with the first year covering courier costs and the second parts (after that it's labour only). It's also a far more stylish and quieter system with room to expand, not to mention numerous options to customise it at the point of purchase. While I wouldn't describe the Ultra R5XT as the perfect Goldilocks PC, it comes close enough to earn a Recommended award. **TIM DANTON**

SPECIFICATIONS

8-core/16-thread AMD Ryzen 7 9700X processor • MSI B850 Gaming Plus WIFI6E motherboard • 32GB Kingston Fury Renegade RGB DDR5-6400 RAM • 16GB Radeon RX 9060 XT graphics • CyberPowerPC V4-NXP air cooler • 2TB Kingston NV3 PCIe Gen 4 SSD • CyberPowerPC Amethyst Curve chassis • Corsair RM750E 750W 80+ Gold PSU • Windows 11 Home • 235 x 460 x 490mm (WDH) • 5yr warranty (1yr C&R, 2yr parts) • power: 68W idle, 330W peak



Your bonus software

Total value
this month
£105

We scour the globe to negotiate the best software deals for our readers, from extended licences to full programs you don't need to pay a penny for. Here's this month's lineup

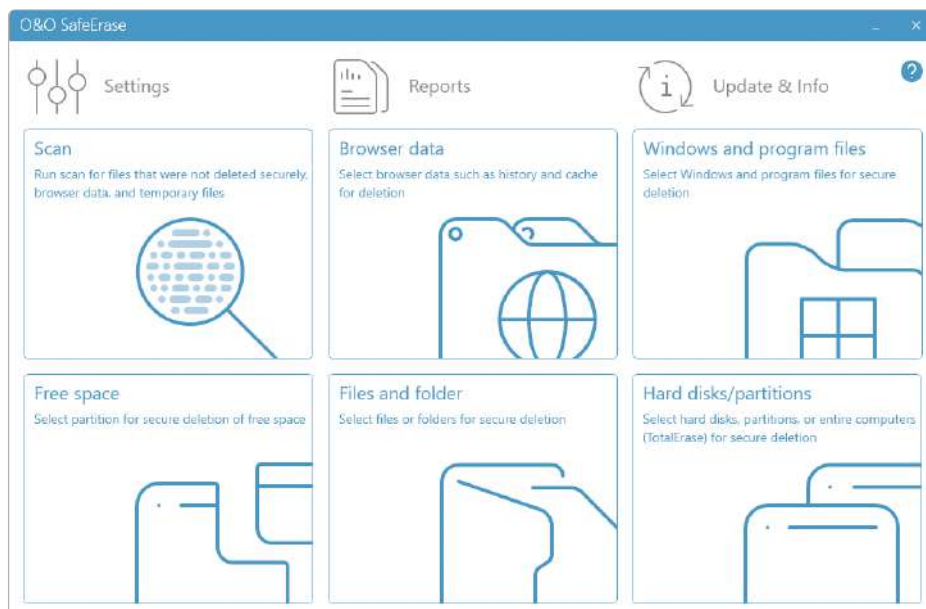
SafeErase 18 Professional

It's tempting to think that deleting a file means it's gone forever – but that's not really the case. Data can often be recovered from your hard drive for a long time after it's supposedly been erased.

That might reassure anyone who doesn't keep backups, but for the rest of us, with potentially sensitive information to look after, it's worrying. The reason data is so easily recovered is that it's not physically deleted from your drive when you empty the Recycle Bin. In order to prevent performance grinding to a halt (and to save wear and tear on your drive), Windows simply marks the file as deleted; the space where it resides is marked as available for reuse, but until it's physically overwritten by other data it remains retrievable.

O&O SafeErase Professional is designed to ensure that data you want to erase is deleted beyond the point of no return. At its most basic level, it can overwrite files with zeros, or employ one of five more thorough methods recognised by the US Department of Defense to ensure deleted files can't be recovered.

■ Full product worth £20
■ oo-software.com REQUIRES Windows 8 or later; 300MB hard drive space; online registration



It also includes tools for securely wiping all traces of your internet browsing, from cookies and downloaded files to pages you've visited. Insecure Windows and program files, such as temporary files and Flash Player cookies, can also be cleaned.

Even data you've previously deleted is no problem: O&O SafeErase can wipe the space where remnants of past files may still reside, and search for unsafe deleted files to speed up the process.

You can also securely erase entire partitions and hard disks – essential if you're planning to sell or recycle an old PC or drive. You can do this from

within Windows itself, so you don't need to create any bootable media beforehand. It uses appropriate methods for wiping SSDs without adversely affecting their lifespan.

All of this power is wrapped up in a simple-to-use interface. Click Start Analysis, and O&O SafeErase will go to work; you can then review its findings and clean up your computer with a single click or work with specific tools for deleting selected files. O&O SafeErase also installs context menu tools, allowing you to delete files securely from within Windows itself.



ABOVE SafeErase starts by scanning your hard disk to detect any recoverable files that can be securely deleted



ABOVE Files created in the background by your day-to-day computer use can also be marked for deletion, protecting your privacy



ABOVE SafeErase works with a range of popular browsers, allowing you to delete your browsing history and other downloaded content

Ashampoo Music Studio 2024

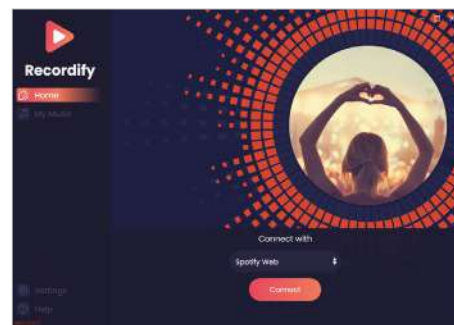
- Easily build and manage your music collection; import from CDs and save as WMA, OGG or WAV audio files
- Record direct from microphone or line-in, or strip the soundtrack from any video
- Edit existing tracks, normalise to keep volume levels consistent, and convert between different formats



■ Full product worth £25 ■ ashampoo.com
REQUIRES Windows 10 or later; 500MB drive space; online registration

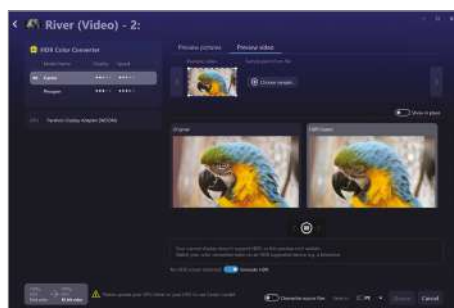
Abelssoft Recordify 2025

- Save streaming audio so you can enjoy it even when disconnected from the internet
- You can also record whatever audio is playing through your sound card, for services not supported directly
- Downloaded files can be saved in MP3 and other common formats, at up to 320Kbits/sec



■ Full product worth £10 ■ abelssoft.net
REQUIRES Windows 7 or later; 50MB drive space; online registration

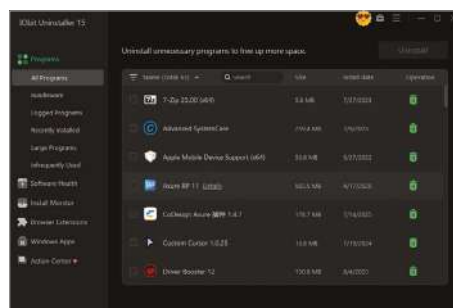
Audials Vision 2025.3 SE



■ SE version worth £20 ■ audials.com
REQUIRES Windows 10 or later; 500MB drive space; in-app registration

- A brand new tool that saves you time by using AI to enhance your videos automatically
- Upscale HD and lower-resolution media to 4K; improve sound quality to enhance dialogue
- Add frames to slow down fast-moving scenes

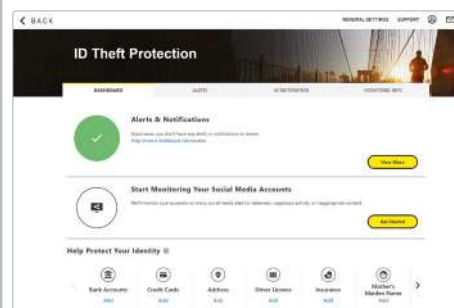
IObit Uninstaller 15



■ Six months of updates licence worth £10 ■ iobit.com ■ **REQUIRES** Windows 7 or later; 100MB drive space; online registration

- Completely remove apps from your drive with no Registry entries or clutter left behind
- Forced Uninstall option for use when original uninstall routines no longer work
- Sort installed programs by size, date and more

Norton Identity Advisor Plus 2025



■ One-account, one-year licence worth £20 ■ uk.norton.com ■ **REQUIRES** Windows 7 or later; iOS 13+; Android 8+; online registration

- Be alerted when your personal information, including your bank details, appears in data leaks
- Monitors online forums, the dark web and more, giving you an opportunity to quickly take action
- Also watches social media accounts

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2 Once you're in the download area, you can access this month's bonus software by navigating to the relevant product page and clicking the red Install button. For trial software, freeware and other downloads, click the Install button below the product description, or follow the onscreen instructions (please make sure to read these carefully).

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Canon Maxify BX110

A tiny inkjet that's perfect for cramped spaces or printing on the road, with high print costs its only downside

SCORE ★★★★★

PRICE £189 (£227 inc VAT)
from printerbase.co.uk

If you want a mobile printer that uses normal A4 paper, you're limited to a portable inkjet. Specifically, the Epson WorkForce WF-110W (see issue 309, p68), HP's nine-year-old OfficeJet 200 and the Canon Maxify BX110 reviewed here.

Despite its tiny size – smaller than a ream of paper – a screen sits on the top with simple control options. The Maxify BX110 even packs a removable lithium-ion battery. Canon claims a 330-page battery life, but as it can recharge over USB-C you can use a mobile power block to keep it going. Back in the office, you can use the DC input to recharge it in about two hours.

That USB-C port can also be used as a simple connection to your laptop, but there's support for Wi-Fi Direct and even an access point (AP) wireless mode that allows you to connect and print from multiple mobile devices. There's no paper output tray, so printed pages simply drop out in front of the device. That works fine on a desk where they stay settled until you're ready to collect them, but it could be an issue for workers on the move.

In transit, the covers fold flat to keep dust out of the paper path, but in use they transform into a paper input tray – albeit one limited to 50 sheets. There's no room for automatic duplex printing, unsurprisingly, although the driver helps you do it manually.

There are two ink cartridges, one black, one tricolour, with Canon promising 200 black or 260 colour pages. Reasonable colour pricing means an A4 page of mixed text and graphics will cost just under 8p (9p inc VAT), with almost half of this figure coming from black ink: at 3.5p (4.2p inc VAT) a page, I suggest you hold off printing memos until you're back in the office and in reach of a full-size printer.

The BX110 is reasonably speedy in mono, hitting 8.5 pages per minute (ppm) in our letter test, with a first



page appearing in 13 seconds. Colour printing was slower, particularly on our complex test, which includes several challenging, graphics-heavy pages. Here, it could deliver only 2.2ppm – I'd expect it to reach significantly faster speeds on more typical, predominantly text-based documents.

This printer isn't optimised for photo printing but is happy to give it a go. We timed six borderless, postcard-sized prints at just over ten minutes. Canon says that the tricolour ink cartridge should last for around 102 photos at this size – that would mean reasonable costs of around 10.6p (12.7p inc VAT) per print. It produced two 10 x 8in prints in six-and-a-half minutes, and I was glad to see the same print speeds whether the Maxify BX110 was operating on mains or battery power.

There's no difference between the quality you get from this printer and what you'd expect from a typical Canon inkjet. Text was bold, black and very crisp by inkjet standards. I saw virtually no bleed-through even

on 80gsm paper and, once dry, characters smudged only slightly under a highlighter.

Graphics were similarly impressive, with strong, authoritative colours dominating the page, making illustrations, charts and other images pop. The only downside was some banding appearing in very dark areas of colour fill, but I suspect most regular users would never notice.

Our test photos were detailed, with only a trace of noticeable grain. The printer delivered a true gloss finish on Canon's own photo papers, and printed without borders on sizes up to and including A4. Photo prints were a touch warm, most noticeably on skin tones, which ended up a shade too pink. It did a good job on our black and white test print, though, producing a nuanced, high-contrast image, with a hint of sepia rather than purely grey shades.

This printer is slower than a full-sized inkjet and more expensive to run, especially when printing in black. It's also missing useful features such as duplex printing, scanning and copy functionality. However, these are all compromises forced by its small size; if mobility is your priority then the Maxify BX110 is a cracker, producing strong print quality at reasonable speeds.

It's in the details where the Canon Maxify BX110 beats our previous favourite mobile inkjet, Epson's WorkForce WF-110W. The BX110's paper tray has more than twice the capacity, and the Canon is significantly cheaper to run – one of my biggest criticisms of the Epson. A single charge of the BX110's battery is good for several times as many pages, and helpfully, you can charge it straight from a car or anywhere else that has a USB port. Together, the Canon Maxify BX110's features and performance make it our new favourite mobile printer. **SIMON HANDBY**

SPECIFICATIONS

4,800 x 1,200dpi A4 colour inkjet ●
50-sheet input tray ● 1.4in OLED screen ●
802.11n Wi-Fi ● Wi-Fi Direct ● USB-C ●
removable battery ● 322 x 185 x 66mm (WDH) ● 2kg ● 2yr RTB warranty

ABOVE Print quality from Canon's Maxify BX110 is outstanding

LEFT Despite its size, there's a screen and simple controls on the top of the printer

"If mobility is your priority then the Maxify BX110 is a cracker, producing strong print quality at reasonable speeds"

BELOW The covers fold flat against the body to aid portability



BenQ RD320

An intriguing 32in 4K monitor designed for programmers, and as usual BenQ delivers great-quality results

SCORE

PRICE £500 (£600 inc VAT)
from benq.eu

Colour me intrigued when BenQ suggested that *PC Pro* review its monitor designed for programmers. Two obvious questions sprung to mind: “Why?” Quickly followed by: “How?”

Answering the first question is relatively simple. Distractions are the absolute enemy of programmers so you need to do everything you can to help them focus: in a monitor’s case that means reducing eye strain and reflections. BenQ’s answer is its Nano Matte technology, adding extra layers to reduce the visibility of overhead lights. This diffused the glare from my spotlights so well that I had to hunt for them against a black background, with the only sign being a weak spread of light.

This is also one of the newer breed of IPS panels with a claimed 2,000:1 contrast ratio, and together with the 4K resolution that means text in your IDEs will look super-sharp. BenQ has also paid attention to the colours, with almost 90% coverage of the DCI-P3 gamut and high accuracy ensuring that colour coding will jump out. There’s also the simple fact that this 31.5in panel can swivel into portrait mode.

If you prefer to work in dark conditions then BenQ offers two more features that will supposedly help keep your eyes on the screen. First is MoonHalo, a ring of LED lights built into the rear of the panel; you can set the brightness and colour temperature (bright white to



almost orange) to your preferences. Then there’s the more commonly found auto dimming feature for the panel itself.

The second feature to help you focus is a choice of two presets: Coding Dark or Coding Light. If you’re using a coding environment with a dark theme switched on in Windows or macOS, then BenQ suggests you use the former; in a light theme, the latter. Both settings had a distinct effect in our testing, with the Coding Dark preset increasing the average Delta E (a measurement of colour accuracy where lower is better) to 3.78 compared to the 0.33 it achieved in sRGB mode. Coding Dark also dropped the contrast ratio to 1,386:1 from 2,004:1. Switching to Coding Light had a similar effect on colour accuracy, but the contrast ratio stayed close to 2,000:1.

I would still use these presets if I bought this monitor for programming, in the unlikely event that I developed programming skills, but switch to one of the other presets when I wanted colour accuracy. And there are plenty to choose from, with M-book for MacBook-like colours, Cinema, Game, HDR, ePaper, sRGB and User. User is the best choice for peak brightness, reaching almost 460cd/m² in our tests, well above the 400cd/m² that BenQ promises.

You can adjust all these settings using the mini joystick tucked behind the “function bar” at the bottom of the screen, but pressing the centre of the bar makes it even

simpler to jump between presets – not simply Coding Dark, say, but also your preferred contrast, blue light setting and “night hours protection” (which sets minimum brightness levels). If you have three favoured presets then you may find yourself using this shortcut all the time, or you can download BenQ’s excellent Display Pilot 2 software and control all the settings from there.

Display Pilot 2 works over USB-C or USB-B, with

BenQ providing two HDMI inputs and one DisplayPort. There’s also a second USB-C port sitting at the rear for daisy-chaining a second monitor, or simply for connecting a peripheral such as a webcam. There’s no RJ45 port, though, and I’m not a fan of positioning the two USB-A ports, third USB-C port and 3.5mm headphone jack at the bottom of the panel: they’re still not easy to access, despite the 20° backwards tilt and 110mm of height adjustment, while protruding cables never make for a nice-looking setup. Also dampen any hopes of a hi-fi experience from the pair of 3W speakers, which are surprisingly weak.

BenQ provides a three-year warranty with all its monitors, with a standard pixel policy: a total of five subpixels can be permanently on or off before it’s considered faulty, with up to two permanently lit and up to

five permanently dark. On a 4K display, though, even five such faults may be tricky to spot, so long as there isn’t a pair of bright subpixels near the centre of the screen.

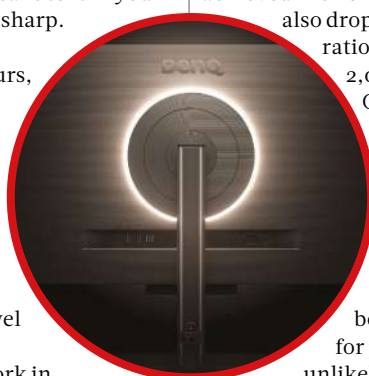
At £500 exc VAT, this is twice the price of the 1440p 32in MSI Modern MD342CQPW that won a Recommended award in our recent Labs (see issue 373, p74), which also included excellent 4K screens that impressed for less. This leaves the BenQ RD320 in a niche for those who truly hate reflections. **TIM DANTON**

ABOVE Superb contrast and colour accuracy ensures that text is pin-sharp

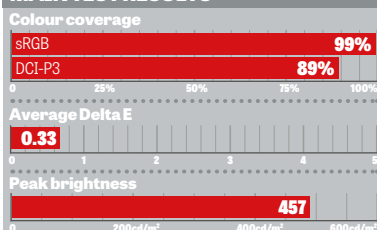
“The Nano Matte technology diffused the glare from my spotlights so well that I had to hunt for them against a black background”

LEFT MoonHalo, a ring of LEDs on the rear, helps keep your eyes focused on the screen

BELOW A further boon for coders is that the display swivels into portrait mode



MAIN TEST RESULTS



SPECIFICATIONS

31.5in 3,840 x 2,160 IPS panel • up to 60Hz refresh rate • 10-bit panel (1.07 billion colours) • 5ms grey-to-grey response time • USB-C (90W) • 2 x HDMI 2.0 • DisplayPort 1.4 • 2 x USB-C 3.2 Gen 2 (7.5W/4.5W) • 3 x USB-A 3.2 Gen 2 • USB-B 3.2 Gen 2 • 2 x 3W speakers • 110mm height adjustment • -5° to 20° tilt • 20° swivel (left/right) • 714 x 263 x 469-579mm (WDH) • 10.8kg • EPEAT Bronze • 3yr advanced exchange warranty • 27W power at 200cd/m²



Cherry Xtrfy MX 10.1 Wireless

Even non-gamers should find much to love about this mechanical keyboard

SCORE ★★★★★

PRICE £233 (£279 inc VAT) from cherryxtrfy.com

Previously we've concentrated on Cherry's office keyboards, but as the pictures give away the German company's Xtrfy brand is focused on gamers. That means per-key RGB lighting and absurdly high polling rates – 4,000MHz over wireless, 8,000MHz if you plug in the supplied 1.8m USB-C to USB-A braided cable. That high wireless polling rate is when you use the RF USB receiver, but you can connect it to up to three devices via Bluetooth too.

Rather than control the RGB via software on your PC, Cherry provides a rotary wheel above the number pad: don't order the tenkeyless version by mistake, which has TKL in its name. The wheel lets you scroll through RGB presets such as Breathing, Wave, Rolling and Static. It's all very obvious,



although you'll need good eyesight to see the text on the tiny screen. You can also use this mini screen to change settings such as the speed of the keys, switch between paired Bluetooth computers and adjust the brightness of the backlight. It's also an excellent way to adjust your PC's volume.

The Xtrfy MX 10.1 Wireless has the distinctive and potentially annoying click common to mechanical keyboards that you either love or hate. Thankfully it's not the harsh, high-toned click that can drive some people crazy, and I soon grew used to it. Switch aficionados may like to know that this keyboard uses Cherry's MX Low Profile 2.0 switches, which I found incredibly sensitive in their default setting – it turns out I rest my finger on the "z" key and had to delete "zzzzzzz" several times. Overall, though, this is a lovely keyboard to type on.

As it should be for this price, and likewise it needs to last, so it's reassuring to see Cherry's promise of "over 100 million keystrokes with no loss of input quality". You're also

ABOVE Per-key RGB lighting and fast polling rates make the Xtrfy MX ideal for gamers

"This keyboard uses Cherry's MX Low Profile 2.0 switches, which I found incredibly sensitive in their default setting"



ABOVE A tiny screen lets you change settings and adjust your PC's volume

paying for polybutylene terephthalate (PBT) keycaps, which have a matte finish and avoid the shininess that comes with thousands of presses on lesser, ABS keycaps. It's a shame the warranty is only two years, though. Also note the keys aren't replaceable. My final word is on battery life. Switch to Bluetooth if you want the

best, with Cherry quoting up to 900 hours here compared to 50 hours over the dongle with 4,000Hz polling. In my unscientific tests, it dropped by between 3-4% per day over Bluetooth, but that's with tame, mid-brightness lighting. While the lack of customisability, via software or keycaps, might put some off, this is a fine keyboard that you may well end up taking with you on the road thanks to a slimline design and sturdy, 1.1kg aluminium chassis. **TIM DANTON**

SPECIFICATIONS

Bluetooth/RF wireless keyboard • mechanical Cherry MX Low Profile 2.0 key switches • per-key RGB backlighting • USB-C (1.8m USB-C to USB-A cable provided) • 4,000mAh battery • supports Windows 7 or later • 427 x 134 x 27mm (WDH) • 1.1kg • 2yr warranty

Cherry KW 300W MX

A compact mechanical keyboard with extremely quiet keys, but it's not cheap

SCORE ★★★★★

PRICE £117 (£140 inc VAT) from shop.cherry.de

Anyone on the hunt for a compact, wireless mechanical keyboard should stop that search right now. The KW 300W MX's appeal starts with the feel of the keys, which use Cherry's sound-dampened MX2A switch. These are full height rather than the shallow travel of the Xtrfy MX 10.1 above, and my fingers delighted in the crisp, deep action.

PBT key caps mean that they should still look as good in ten years as they do today, and while the grey finish and simple white backlighting won't turn heads there are numerous nice details. For instance, I like the subtle Cherry logo beneath the space bar, and the flip-up feet at the rear provide



the slightest of angles to make typing more comfortable. I also appreciate the red LEDs to indicate if the caps lock or function lock are active.

You control the strength of the backlight using the rotary dial on the right-hand side, or to control volume. It's all incredibly logical and means you don't need to resort to software.

I have two minor complaints. One is that the numbers aren't backlit on the keyboard, only the secondary function (such as "!", "£", "\$"), and so I sometimes found myself mistakenly typing 4 when I meant to aim for 5. Second, there are no dedicated Home or End keys, with function doubling on the Pg Up and Pg Dn keys instead.

But that's it for negatives. Battery

ABOVE Cherry's KW 300W MX is blessed with sound-damped, full-height keys



LEFT Flip-up feet at the rear create an angle that makes typing more comfortable

life is solid, with a week's life if you have backlighting on and up to two months without. And it's easy to recharge by simply plugging in the supplied 1.8m braided USB-C to USB-A cable. Naturally it can also work in this mode, but you'll mainly be using it as a Bluetooth keyboard (there's no RF receiver), with up to three connections supported.

This is a Windows-only keyboard, but if you buy the KW 300 MX (rather than 300W) it includes Mac keys in the box. You can then swap them out using the supplied tool. But, for now at least, this is only available in German and US configurations. Whichever you choose, this is an excellent, compact keyboard that should last for many years. **TIM DANTON**

SPECIFICATIONS

Bluetooth wireless keyboard • mechanical Cherry MX2A switches • ten-level white backlighting • USB-C (1.8m USB-C to USB-A cable provided) • lithium-ion battery (capacity not disclosed) • supports Windows 7 or later • 320 x 135 x 39mm (WDH) • 747g • 2yr warranty

ReMarkable Paper Pro Move

Nearly the perfect tablet for writing and drawing on the move thanks to its compact size and pen-on-paper feel

SCORE ★★★★★

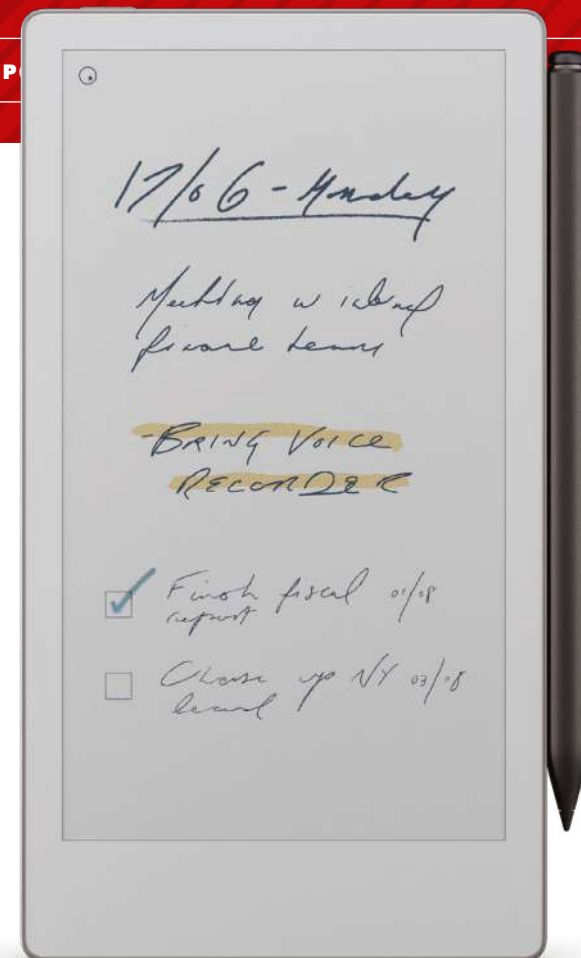
PRICE £339 (£399 inc VAT)
from remarkable.com

The reMarkable Paper Pro Move is an expensive tablet: it costs £399 inc VAT with a standard Marker stylus, or £439 with a Marker Plus, which adds an eraser function to the opposing end. Is it worth the extra £40 just for a dedicated eraser? If you're asking that question, you're considering the wrong tablet. This is a luxury lifestyle device for the executive who has everything.

To be more precise, the reMarkable Paper Pro Move is a thin and very lightweight writing tablet. Despite its lightness, it feels very solid: I had no trouble holding it in my left palm and writing comfortably across the whole page with my right. Then I just tucked it into the back pocket of my jeans. I've always wanted a tablet like this.

The design couldn't be simpler. The only button is the power button; there are no speakers, so there's no need for a volume control. The pen attaches magnetically, and recharges its internal battery while connected, so I like to use a case to ensure it doesn't get knocked off. ReMarkable offers both leather and cloth folio options, at an extra cost of £119 and £89 respectively if you order at the time of purchase. Notably, there's no keyboard cover for the Move; I think it would be cool to see a mini keyboard for this tablet.

Other than its size, the most distinctive thing about the Paper Pro Move is its colour E Ink display (reMarkable calls it Canvas Color). This looks fantastic – much more like real paper than a regular LCD panel. And writing on it feels exactly like using my favourite Pilot Precise rollerball pen on a thick Moleskine notebook. When the results appear, themselves looking remarkably like



real ink on real paper, the effect seems magical. The responsiveness helps: while you're taking notes, there's no perceptible delay between touching the Marker Plus to the screen and the E Ink appearing. If you write calligraphy or draw with the paint brush tools, you'll really appreciate the responsiveness.

Note, though, that even the fastest E Ink displays react much more slowly than a conventional screen, and if you draw in colour you'll see the display shift a few times after you lift the pen as it renders the final image. Personally, I think this looks great – it reminds me of steampunk and alternative future display concepts. I realise that others will find it frustrating.

The reMarkable software lets you organise your notes into virtual notebooks, and save them in folders. You can also insert tags throughout notebooks to make them easier to search. A new feature that uses AI to convert handwriting into typed, searchable text sounds useful, but I found the results ranged from useless to dangerously hilarious: many of my handwritten words were misread, and in one case came out X-rated.

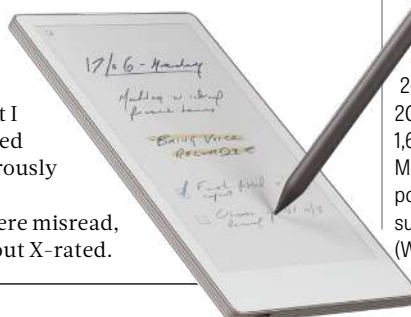
ABOVE Thin, light and solid, this is a luxury lifestyle device for the discerning executive



LEFT Writing on the E Ink display feels incredibly similar to writing on paper

"The most distinctive thing about the Paper Pro Move is its E Ink display. This looks much more like real paper than a regular LCD panel"

BELOW The superb pen recharges automatically when attached to the tablet



Still, since the conversion happens in the cloud, I'm hopeful that reMarkable can quickly fix this by hooking up with a better service – for example, I've seen much better AI-based handwriting recognition on the Kindle Scribe.

Other than that, the operating system is extremely simple, almost pointedly so. There's no clock, for instance, so you won't be hassled by the time. There are no alerts or notifications. The Move won't ever buzz or vibrate for your attention. It also won't serve you ads in any way, or spam you with messages.

As for battery life, I've had the tablet for more than two weeks and I've charged it twice, including the initial charge time. That's pretty good for modern electronics; larger tablets such as the reMarkable Paper Pro (see issue 362, p64) can run for longer on a full battery, but I don't mind charging the Move every week or so. Actually, it's possible the Paper Pro Move has been dying faster because I'm using it more – after all, when you can stuff a tablet into your back pocket, it's always at hand.

I have a few criticisms. For one, the integrated lights aren't very powerful; you'll need an extra source of illumination if you want to jot down a diary entry after lights out. More disappointingly, with this latest tablet, reMarkable has taken a step over to the dark side: unlocking the full range of note-taking templates, and connecting the device to mobile apps and cloud storage, requires a monthly subscription. This doesn't cost a lot (£2.99 a month), but it stings that an ultra-simple tablet with a premium price needs an additional subscription plan.

Despite those minus points, the reMarkable Paper Pro Move is the most effective and pleasant writing tablet I've ever used. The size is perfect, the features are focused, the writing experience is divine. Make no mistake, this is not a general-purpose

device: it won't let you run your favourite apps, chat with an AI or browse the web – if you want more, you'll need to look elsewhere. But if you need less, the Paper Pro Move is the perfect solution. **PHILIP BERNE**

SPECIFICATIONS

2-core 1.7GHz Cortex-A55 processor ● 2GB RAM ● 7.3in Canvas Color E Ink display, 1,696 x 954 resolution ● 64GB storage ● Marker stylus ● Wi-Fi 5 ● USB-C 2 ● accessory port ● 2,334mAh battery ● reMarkable OS ● supports PDFs, EPUB ● 109 x 6.5 x 196mm (WDH) ● 230g ● 1yr limited warranty



Google Pixel 10 Pro

A limited upgrade over last year's model, but the new Pixel standard-bearer barely puts a foot wrong



SCORE ★★★★★

PRICE 256GB, £916 (£1,099 inc VAT)
from store.google.com

If you're a *PC Pro* Podcast listener, you might have heard me proposing the Pixel 10 Pro as Hot Hardware of the Week. You'll also have heard me being decisively voted down by a sceptical audience. I'm here now to tell you why the listeners were right – but why I still think it's a great phone.

I speak from experience, having bought the Pixel 10 Pro on launch day as an upgrade from my trusty Pixel 7 Pro (see issue 339, p72). The new phone has some definite attractions if you're coming from a handset released back in the heyday of Liz Truss. For one thing, the physical design is completely different; the new format was introduced last year with the Pixel 9 Pro (see issue 362, p58), but it will still be a big change for anybody who's been using an older Pixel. It has a strikingly similar appearance to the iPhone 16 Pro (see issue 363, p70), to the extent that my wife and I keep picking up one another's phones – but that's another way of saying it's one of the most premium-feeling, beautiful-looking handsets on the market. It's just a shame the colour options are so dull, with Obsidian, Moonstone, Porcelain and Jade finishes basically translating to black, grey, off-white and a slightly sickly pale green.

Recent Pixel Pro models no longer come with an extra large screen; if 6.3in isn't enough you'll need to pay at least £1,199 for the 256GB Pixel Pro XL and its 6.8in panel. But while the 10 Pro's display is of an ordinary size, it's

extraordinarily bright, with a peak of 3,300cd/m². It literally outshines rivals such as the Samsung Galaxy S25 Ultra (2,600cd/m²) and the iPhone 16 Pro (2,000cd/m²), and even beats the new iPhone 17 Pro, which tops out at 3,000cd/m². This isn't something you notice every day – the phone sensibly keeps itself at a moderate setting when you're sitting around the house – but already a few times I've been out on the blazing sun, thinking “gee, it would be nice to check my phone right now”, and to my amazement have found it perfectly legible.

■ Camera pluses

One thing that initially excited me about the Pixel 10 Pro was the camera. The photographic hardware hasn't significantly changed in years, and I can't actually detect any difference in quality between photos taken on this and my Pixel 7 Pro. That's certainly not a complaint – they all look fantastic, with astonishing low-light performance. And I still adore the 5x optical zoom, which I've used many times to get beautifully framed nature shots that I could never have captured with another phone – not without resorting to the dreaded digital zoom.

Yet it's the digital zoom that makes the Pixel 10 Pro special, because while the hardware hasn't been meaningfully updated, the software has gained a new feature called Pro Res Zoom. This exploits AI more freely and creatively than ever before, to interpolate detail at high magnification levels and make bland, smeary blow-ups a thing of the past. It generates images that look sharp and natural all the way up to a ridiculous 100x zoom – something I couldn't wait to try.

ABOVE It may not be the hottest phone you can buy, but the Pixel 10 Pro is still a winner

Now that I've put it to the test, I have to say it's more of a party trick than a useful feature. It's hard to frame a decent photo from 100 metres away, and the zoom doesn't really work as a handy telescope in your pocket because the fine detail is all invented, with text being morphed into weird alien glyphs. Even so, it's a lot of fun to be able to push well beyond the limits of the optical zoom and still get

nice-looking results, even if they're not a true representation of reality.

“While the 10 Pro's display is of an ordinary size, it's extraordinarily bright, with a peak of 3,300cd/m². It literally outshines rivals”

■ AI smarts

For US users, there's also a new voice-powered photo-editing feature

that lets you dictate your desired adjustments to the on-device AI assistant. There's no word on when this will come to the UK, but I hope it's soon – it sounds like a smart bit of joined-up technology, taking the fiddly fat-fingered frustration out of removing the tourists from your lovely picture of Trinity College chapel.

Another bit of AI I'm enjoying is the Pixel screenshots app. Introduced last year with the Pixel 9 series, this not only puts all my screenshots neatly in one place, it lets me search their text, so I can instantly retrieve the measurements of those Ikea

PRICES OF GOOGLE PIXEL 10 PHONES

	Pixel 10	Pixel 10 Pro	Pixel 10 Pro XL	Pixel 10 Pro Fold
128GB	£799	£999	Not offered	Not offered
256GB	£899	£1,099	£1,199	£1,749
512GB	Not offered	£1,219	£1,319	£1,869
1TB	Not offered	£1,449	£1,549	£2,099

All prices inc VAT from Google Store

wardrobes I was looking at – as long as I remembered to take a snapshot of the website while browsing. That part might require me to update my habits, but again this is the sort of practical application of AI that I really dig.

It's worth mentioning that the Pixel 10 Pro comes with a year of Google AI Pro, giving you extended access to AI assistant features (including image and video generation), and unlocking AI tools in numerous Google apps. Your Google Drive storage is also upgraded to a huge 2TB – until the year runs out, at which point you'll have to decide whether it's worth £19 a month to keep it going.

There are some features of the Pixel 10 Pro I can take or leave. The new Camera Coach feature, exclusive to Pixel 10-series phones, is an okay idea, with the phone analysing your surroundings and suggesting shooting modes and styles for the best results. It's not a quick-fire thing, though – you need to spend a minute or two working through its suggestions, so it only really works with static scenes.

Another Pixel 10-only feature is Magic Cue, which is supposed to intelligently bring up content that's relevant to your communications. I turned this on on day one, but so far I haven't seen it pop up once. Google's marketing implies that Magic Cue is particularly useful for voice calls, when you don't want to be hunting through apps for information, so that might explain things; personally, I make very few calls, and when I do it's normally just a quick one to say "did you see my email?" Anecdotally I hear I'm not the only one who's yet to see Magic Cue in action, but perhaps it will become more visible over time.

Hardware times

Let's talk next about the hardware that powers all Pixel 10 handsets: the new Tensor G5 processor, now shrunk down to three scintillating nanometres. Its benchmark scores are between 20% and 30% higher than the Pixel 9 Pro, but it's still nowhere near as fast as the Qualcomm chips in other high-end Android phones. Just glance at the graph above to see the gulf in both CPU and gaming performance.

Yet while that's not a good look, I suggest you don't get too anxious about it. When you're actually running apps, or switching back and forth between them, the phone feels supremely snappy. If benchmarks didn't exist, I sincerely doubt that anyone would find a bad word to say about the Pixel 10 Pro's performance – unless perhaps they wanted to use it for 4K video editing, or PlayStation-grade gaming.

GEEKBENCH 6 (SINGLE CORE)

Apple iPhone 16 Pro Apple A18 Pro, 6-core graphics	3,400
Samsung Galaxy S25 Ultra Snapdragon 8 Elite, Adreno 830	3,031
Google Pixel 10 Google Tensor G5, DXT-48-1536	2,345
Google Pixel 10 Pro Google Tensor G5, DXT-48-1536	2,335
Google Pixel 10 Pro XL Google Tensor G5, DXT-48-1536	2,322
Google Pixel 9 Pro Google Tensor G4, Mali-G715 MC7	1,948

HIGHER IS BETTER

GEEKBENCH 6 (MULTICORE)

Samsung Galaxy S25 Ultra Snapdragon 8 Elite, Adreno 830	9,829
Apple iPhone 16 Pro Apple A18 Pro, 6-core graphics	8,391
Google Pixel 10 Google Tensor G5, DXT-48-1536	6,581
Google Pixel 10 Pro Google Tensor G5, DXT-48-1536	6,375
Google Pixel 10 Pro XL Google Tensor G5, DXT-48-1536	6,286
Google Pixel 9 Pro Google Tensor G4, Mali-G715 MC7	4,794

HIGHER IS BETTER

3DMARK WILD LIFE EXTREME (FPS)

Samsung Galaxy S25 Ultra Snapdragon 8 Elite, Adreno 830	37
Apple iPhone 16 Pro Apple A18 Pro, 6-core graphics	27
Google Pixel 10 Pro XL Google Tensor G5, DXT-48-1536	21
Google Pixel 10 Google Tensor G5, DXT-48-1536	20
Google Pixel 10 Pro Google Tensor G5, DXT-48-1536	19
Google Pixel 9 Pro Google Tensor G4, Mali-G715 MC7	15

HIGHER IS BETTER

BATTERY LIFE (WEB RUNDOWN)

Samsung Galaxy S25 Ultra Snapdragon 8 Elite, Adreno 830	18hrs 36mins
Google Pixel 10 Pro XL Google Tensor G5, DXT-48-1536	14hrs 21mins
Apple iPhone 16 Pro Apple A18 Pro, 6-core graphics	14hrs 8mins
Google Pixel 10 Pro Google Tensor G5, DXT-48-1536	13hrs 43mins
Google Pixel 9 Pro Google Tensor G4, Mali-G715 MC7	13hrs 31mins
Google Pixel 10 Google Tensor G5, DXT-48-1536	13hrs 13mins

HIGHER IS BETTER

Battery life is another case of "good enough". A full charge got me easily through a full day, even when I spent longer than I should flicking between Gardenscapes and Threads, so I'm happy about that. It's notable, however, that the Pixel 10 Pro conked out in our tests hours before its rivals; that suggests that battery life could become an irritation in three years' time, when the capacity has dropped to 80%.

The recharging situation isn't exactly thrilling, either. The new Pixel range supports Qi2 wireless charging, which Google calls Pixelsnap (and Apple calls MagSafe) – the system where the wireless charger comes in the form of a round paddle, which snaps magnetically onto the back of your phone.

While having more charging options is never a bad thing, I'm not convinced that Pixelsnap is much more convenient than using a standard pad, or indeed just plugging a regular charging cable into the bottom of the thing – especially since the Pixel 10 Pro can only charge wirelessly at a maximum of 15W, whereas cable charging goes up to 30W.

Both of those numbers also feel rather low next to Samsung's 45W wired charging, while OnePlus's crazy SuperVOOC system goes as high as 100W. And it's not much consolation to note that faster speeds are available on the bigger, pricier Pixel 10 Pro XL. Is the Pixel 10 Pro supposed to be a "flagship" phone or not?

The Galaxy question

When you focus on specifics like that, the Pixel 10 Pro does seem

BELOW The camera hardware is the same as the Pixel 9, so photos are just as impressive



like a questionable investment. The 256GB model costs the same as the equivalent Samsung Galaxy S25 Ultra (see issue 367, p70), yet lags well behind it in performance, battery life and charging speed. Nor is the everyday user experience much different to that of the Pixel 9 Pro, still available for £100 less and officially supported for another six years. As I say, I can't argue with the verdict of our podcast audience: "hot" is not the word.

All the same, in the weeks I've been using the Google Pixel 10 Pro I haven't regretted my purchase once. Perhaps the advertised gimmicks haven't translated to a massive uplift in my quality of life, but equally I haven't run into any infuriating gotchas, coercive marketing-led design decisions or penny-pinching compromises. Everything works smoothly and solidly, and that's not something you can say for every device. In my book it's justification

enough to choose the Pixel 10 Pro over the competition – at least if you're someone who appreciates the Google way of doing things.

DARIEN GRAHAM-SMITH

"In the weeks I've been using the Pixel 10 Pro I haven't regretted my purchase once. Everything works smoothly and solidly"

SPECIFICATIONS

8-core Google Tensor G6 processor • 16GB RAM • Mali-G715 MC7 graphics • 6.3in 120Hz LTPO AMOLED screen, 1,280 x 2,856 resolution • 5G • 128GB/256GB/512GB/1TB storage • nano SIM and eSIM • IP68 rating • triple 50MP/48MP/48MP rear cameras • 42MP front camera • Wi-Fi 7 • Bluetooth 5.3 • NFC • 4,700mAh battery • USB-C 3.2 Gen 2 connector • Android 15 • 72 x 8.5 x 153mm (WDH) • 199g • 1yr warranty

LEFT This is one of the most premium-feeling, beautiful-looking handsets you can buy

Google Pixel 10

The closest Google has come to hitting the iPhone bullseye, even if it misses out on some AI features

SCORE ★★★★★

PRICE 128GB, £666 (£799 inc VAT)
from store.google.com

If the Pixel 10 Pro on the previous pages is too pricey, the regular Pixel 10 offers several of the same signature features for a lower price, including magnetic charging and a 5x zoom camera. It also comes in a more fun selection of colours, namely Indigo, Frost and Lemongrass, as well as the sombre Obsidian.

Its design is all but identical to this year's Pixel 10 Pro, to the extent that you can use the same case for either phone. The biggest difference from last year's Pixel 9 is that there are now internal magnets at the back, but these don't have any discernible impact on the phone's thickness or weight. You can't see the magnets, but you can feel them. Google has made its "PixelSnap" feature – its variant on MagSafe – with very strong magnets, and the phone holds fast to the various PixelSnap accessories even if you shake it around.

The display is one of the best you'll see on any smartphone; I don't think Google brags enough about the bright, clear screens on all of its Pixel phones. It's far brighter than the iPhone 16 or Galaxy S25, and is especially helpful for taking photos in bright sunlight. The display is just as colourful as the vibrant Pixel 10 Pro, so the only real difference is that it has a lower resolution, but I doubt you'd notice a difference. Overall, it's great for videos and games.

In fact, this phone is a pleasure to use in every situation. I found the homescreen easy to set up with app shortcuts and widgets, and I love the way Google's widgets automatically colour-coordinate to the theme of your phone. They even change to darker hues as the sun sets and night begins. The only bum note is the Settings interface, which remains a mess: you're faced with a jumble of disorganised features popping up in long lists of



options. Still, it's worth the pain of digging through these as otherwise you might miss out on AI features.

One major new feature is Magic Cue, which pops up pertinent information from your Gmail, Google Calendar and so forth at helpful moments. For example, if a friend sends you a text message asking about a dinner reservation, it might offer you a button to open the confirmation email or a link to the address on Google Maps. Or say your friend John wants to meet your friend Susan, Magic Cue will give you Susan's phone number and contact card to send to John. I can picture its capabilities expanding dramatically to become a major part of the Android experience.

The Pixel 10 also benefits from the new Live Translation feature, which translates your voice into another language over the phone while keeping your original tone. Other features are restricted to the Pixel 10 Pro, including automatically screening calls from unknown numbers and the (currently US-only) option to generate notes from live conversations. That concerns me: the Pixel 10 is supposed to receive seven years of Android updates, but on day one it's already missing out on features. What else will it be missing in a few years' time?

ABOVE The Pixel 10 shares many of the high-end features of the Pixel 10 Pro



"The Pixel 10 is a durable, functional phone that's easy to use. It takes great photos and packs genuinely useful AI features"

LEFT The Pixel 10's superb cameras include a 5x optical zoom lens

I have more positive news on the camera front. The Pixel 10 takes fantastic photos that look remarkably like images captured with the Pixel 10 Pro, which is one of the best camera phones you can buy. You don't get the same resolution, but the colour and tonal balance is superb. Even more exciting, the Pixel 10 includes the 5x optical zoom lens that was previously only available on Pro models, and the new AI-powered Camera Coach feature can help you learn to use it.

Inside, the Pixel 10 uses the same silicon as the Pixel 10 Pro. That means it's a slow phone by benchmark standards, but strangely it was faster than the Pixel 10 Pro in some tests, despite having only 12GB of RAM compared to 16GB. In any case, most users will never notice: for daily tasks and navigating the phone's menus, it felt zippy. Apps open quickly and the menus and homescreens flashed by as I swiped through them.

I did see slowdown when playing intense games: the phone stutters if you try to play *Call of Duty Mobile* with the performance settings maxed out, or if you run through *Vampire Survivors* with hundreds of enemies on the screen at once. Outside of those extreme scenarios, though, I didn't notice any performance problems.

As for charging, I'm a big fan of PixelSnap for bedside charging – it's just so easy to pop your phone onto a magnetic stand at night. Once charged, the Pixel 10's battery usually lasted me through a full day of testing, unless I was hitting the Camera app extra hard. It did fall two hours short of the Samsung Galaxy S25 (see issue 367, p72) in our tests, but magnetic charging makes it easy to top up your phone throughout the day.

The Pixel 10 is a durable, functional phone that's easy to use and enjoy. It takes great photos and packs genuinely useful AI features. It's disappointing that it can't do everything the Pro model can, which is one big reason to choose the pricier model. However, if you're not concerned about ticking off every AI feature on the list then you can save a decent chunk of money and buy the Pixel 10 with confidence. **PHILIP BERNE**

SPECIFICATIONS

8-core Google Tensor G5 processor • 12GB RAM • Mali-G715 MC7 graphics • 6.3in 120Hz AMOLED screen, 1,080 x 2,424 resolution • 5G • 128GB/256GB storage • nano SIM and eSIM • IP68 rating • dual 50MP/48MP rear cameras • 10.5MP front camera • Wi-Fi 7 • Bluetooth 5.3 • NFC • 4,700mAh battery • USB-C 3.2 Gen 2 connector • Android 14 • 72 x 8.5 x 153mm (WDH) • 198g • 1yr warranty

pro-series



£449.99

CPU AMD RYZEN 5 8500G
Core 6 Cores - 12 Threads
Clock (3.5/5Ghz Turbo)
Mob ASUS TUF A620M-PLUS WIFI
RAM ADATA 16GB DDR5 5600Mhz
M.2 TRANSCEND 1TB M.2 nVME
GPU AMD RADEON Graphics
Case KOLINK Observatory HF MESH
O/S *NO OPERATING SYSTEM*
PSU BUILDER 500W PSU



£979.99

CPU AMD RYZEN 5 7600X
Core 6 Cores - 12 Threads
Clock (4.7/5.3Ghz Turbo)
Mob ASUS PRIME B650M-A WIFI II
RAM ADATA 32GB DDR5 5600Mhz
M.2 TRANSCEND 1TB M.2 nVME
GPU NVIDIA RTX4060 TI 16GB
Case 1stPlayer D3-A aRGB - Black
O/S *NO OPERATING SYSTEM*
PSU CIT 700W PSU



£1159.99

CPU INTEL Core i5 14600K
Core 14 Cores - 20 Threads
Clock (2.6/5.3Ghz Turbo)
Mob ASUS B760M-K
RAM ADATA 32GB DDR5 5600Mhz
M.2 ADATA 2TB S70 Blade M.2 nVME
GPU NVIDIA RTX4060 TI 16GB
Case GAMEMAX F15M MESH
O/S *NO OPERATING SYSTEM*
PSU BEQUIET 850W Gold PSU

Aurora RANGE



£629.99

CPU INTEL Core i3 14100F
Core 4 Cores - 8 Threads
Clock (3.5/4.7Ghz)
Mob ASUS B760M-K
RAM ADATA 16GB DDR5 5600Mhz
M.2 TRANSCEND 1TB M.2 nVME
GPU NVIDIA RTX3050 8GB
Case GAMEMAX Abyss Mini RGB
O/S MICROSOFT Windows 10/11
PSU CIT 600W Bronze PSU



£999.99

CPU INTEL i5 14400F
Core 10 Cores - 16 Threads
Clock (Turbo 4.7Ghz)
Mob ASUS B760M-K
RAM CORSAIR 32GB DDR5 6000Mhz
M.2 ADATA 2TB M.2 NVMe
GPU NVIDIA RTX4060 8GB
Case CORSAIR iCUE 4000X
O/S MICROSOFT Windows 10/11
PSU CORSAIR 650W PSU



£1599.99

CPU INTEL Core i7 14700KF
Core 20 Cores - 28 Threads
Clock (3.4/5.6Ghz Turbo)
Mob ASUS PRIME Z790-P WIFI - DDR5
RAM CORSAIR 32GB DDR5 6000Mhz
M.2 ADATA 1TB S70 Blade M.2 nVME
GPU NVIDIA RTX4070 12GB
Case CORSAIR iCUE 4000X RGB
O/S MICROSOFT Windows 10/11
PSU CORSAIR 650W Gold PSU

www.palicomp.co.uk



OnePlus Nord 5

A curious mix of upgrades and downgrades mean this mid-range offering fails to sparkle

SCORE ★★★★★

PRICE 8GB/256GB, £333 (£399 inc VAT)
from [oneplus.com](https://www.oneplus.com)

OnePlus' Nord phones promise a taste of the high end at an affordable price, and the new Nord 5 costs a very reasonable £399 with 8GB of RAM and 256GB of storage. That's £30 less than last year's Nord 4, a welcome reversal of inflationary trends. Then again, that phone had 12GB of RAM; if you want that this year, you'll have to move up to the 12GB/512GB model at £499.

The Nord family is not known for its beauty, and the Nord 5 is one of the most boring-looking phones I've seen – a big, chocolate-bar-style box, offered in grey, white and ice blue. At 211g it's slightly heavier than your average phone, and with its huge 6.83in screen it feels a little oversized in the hand.

That's not merely a subjective issue; I found the power button and volume rocker on the right edge quite hard to reach with my thumb. I do, however, like the customisable Plus key on the other side, which can open the camera, turn on Do Not Disturb, light the torch or activate other options. It's a good enhancement of the old alert slider.

The screen is protected by Sliding Gorilla Glass 7i, and the glass on the back gives the phone a premium feel in the hand, although I found it readily picked up fingerprints, and I worry about how breakable it might be. Talking about durability, the handset has an IP65 rating, so it's protected against jets of water, but not submersion in liquid.

One of the OnePlus Nord 5's best features is its AMOLED display. Its size may raise ergonomic issues, but it gives you masses of space to enjoy games and videos. It supports over a billion colours, with a respectable maximum brightness of 1,800cd/m² – down from the 2,150cd/m² of its predecessor. The unusual 144Hz refresh rate may only be useful for a few specific games, but it's nice to



have, and I'm a fan of OnePlus' "Aqua Touch" technology, which keeps the touchscreen accurate even when the display (or your finger) is wet.

OnePlus' OxygenOS 15, layered over the top of Android 15, is close to stock Android in layout but quite distinct in aesthetic, with bold, punchy colours. Custom features include Zen Space (which locks your phone for a set time while you work) and a translation app. OnePlus promises four years of Android updates, plus a further two years of security updates.

The worst part of the software experience is all the bloatware, with unwanted games, social media apps and OnePlus-branded additions all cluttering up the homepage. However, the Nord 5 didn't bombard me with AI features or gimmicks; other than the replacement of Google Assistant with Gemini, the Nord 5's AI features are largely confined to the camera.

This is perhaps the right place for OnePlus to focus, as the camera hardware is largely unchanged from the previous-gen model. The handset packs a 50MP f/1.8 main and 8MP f/2.2 ultrawide camera, both of which are totally fine, producing bright, detailed pictures. However, you're not getting amazing dynamic range or smart optimisation, nor the versatility of a zoom

ABOVE The OnePlus Nord 5 is good value for a blazingly fast Android device

LEFT The 50MP main and 8MP ultrawide lenses produce bright, detailed pictures

"The Nord 5 is a decent-value Android phone. With its high-spec display and processor, it often feels like a top-end mobile"

LEFT The phone's size means the power and volume buttons can be hard to reach

lens. The phone also has a tendency to blow out the lighter areas of a shot, while losing detail in the darker parts.

AI features include the expected eraser tool for removing unwanted background items, as well as a tool to reframe pictures (which basically just crops them). There's also a detail boost, which can help if you've zoomed in too far, an unblurrer for objects in motion and a reflection eraser, which works quite well – all helpful ways to improve imperfect photos.

OnePlus touts the Nord 5's performance as a key selling point, and you can see why. It's built on the Qualcomm Snapdragon 8s Gen 3, a slightly cut-down version of last year's top-end Android chipset. It makes the phone blazingly fast: it averaged 5,147 in the

Geekbench multicore test, and I'd say anything above 4,500 is fantastic. You can feel the performance when gaming or photo editing, or just whizzing around the phone's menus. I should note, however, that I tested the 12GB model; I can't speak to how the 8GB version runs.

Battery-wise, the OnePlus Nord's 5,200mAh power pack will get you through a day with no sweat, and even into day two with light use. However, the bigger screen means it doesn't last as long as the Nord 4 did, and the maximum charging speed is also reduced from 100W to 80W. That's still very fast, though, and you can now use a USB cable to charge other devices from the Nord.

The Nord 5 is a decent-value Android phone. With its high-spec display and processor, it often feels

like a top-end mobile. However, it looks boxy, the camera is merely fine, and in more than one area the hardware is actually a downgrade on last year's model.

If you're considering the OnePlus Nord 5, I wouldn't dissuade you, but I'd definitely suggest you also check the current pricing of the Nord 4. **TOM BEDFORD**

SPECIFICATIONS

8-core 3GHz/2.8GHz/2GHz Qualcomm Snapdragon 8s Gen 3 SoC • 8GB/12GB RAM • Adreno 735 graphics • 6.8in 120Hz AMOLED screen, 1,272 x 2,800 resolution • 5G • 256GB/512GB storage • IP65 • dual 50MP/8MP rear cameras • 50MP front camera • Wi-Fi 6 • Bluetooth 5.4 • NFC • 5,200mAh battery • USB-C 2 • Android 15 with OxygenOS 15 • 77 x 8.1 x 163mm (WDH) • 211g • 2yr warranty

Aqara Doorbell Camera Hub G410

Redefine every arrival with 2K clarity and a precise mmWave sensor. Beyond a doorbell, the Aqara Doorbell Camera Hub G410 serves as a smart home hub—recognizing familiar faces, supporting automations settings, and connecting Aqara and Matter-compatible devices across leading platforms. Flexible, secure, and effortless, it brings smarter, safer, and more welcoming homes to life.

Discover the Aqara G410 and let home greet you like never before.





MINI PC WONDERS

We put a dozen tiny computers through our digital wringer, so whether you're looking for an office companion or an all-rounder for personal use we have the answer

You've got to love mini PCs. If you've spent years hefting massive PC cases around offices, it's a revelation to switch to the size and simplicity of these little boxes. Connect a power lead and monitor cable, hook up a keyboard and mouse, press "on" – and you'll discover a surprisingly capable computer.

Office work? Covered. Likewise creative apps, whether for music, film or photography. Want to do a bit of coding, even gaming? Certainly, if you don't expect too much. Mini PCs represent such an easy, tidy ownership experience that it's hard to make the argument for a full-sized device save for hardcore gamers or the most megalomaniacal of power users.

In fact, we suggest you leave most of your assumptions at the door. Some of the smallest mini PCs in this test turn out to be the most powerful, while a few of the bigger ones flatter to deceive. And while price continues to be the best indicator of all-round skills, it isn't always to be trusted.

How fortunate that we're here to help, whether through our exhaustive performance graphs from p94, our detailed comparison table of the mini PCs on test overleaf, or a buyer's guide to help you make the right decision – whether you choose a mini PC from this selection or not.

CONTRIBUTOR: Simon Handby

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	Acer Veriton N6 VN6710GT	Asus ExpertCenter PN54	RECOMMENDED Asus NUC 14 Pro AI	Geekom A5	Geekom Mini IT12	Lenovo ThinkCentre M75q Gen 5
Overall rating	★★★★☆	★★★★☆	★★★★☆	★★★★☆	★★★★☆	★★★★☆

Buying information

Price of reviewed system ¹	£420 (£504 inc VAT)	£1,145 (£1,374 inc VAT)	£1,000 (£1,200 inc VAT)	£224 (£279 inc VAT)	£416 (£499 inc VAT)	£551 (£661 inc VAT)
Starting price of range	£420 (£504 inc VAT)	£925 (£1,109 inc VAT)	£700 (£840 inc VAT)	£224 (£279 inc VAT)	£316 (£379 inc VAT)	£424 (£509 inc VAT)
Supplier website	ballicom.co.uk	amazon.co.uk	asus.com/uk	geekom.co.uk	geekom.co.uk	lenovo.com/uk
Part code	DT.ROSEK.001	PN54-S70012NN	NUC14LNK	✗	✗	12RQCT01WWGB2
Warranty	1yr RTB	1yr RTB	1yr RTB	3yr RTB (first six months C&R)	3yr RTB (first six months C&R)	3yr on-site

Processor & memory

Processor	Intel Core i5-13500T	AMD Ryzen AI 7 350	Intel Core Ultra 9 238V	AMD Ryzen 5 7430U	Intel Core i7-1280P	AMD Ryzen 5 Pro 8500GE
Cores	6 P-cores, 8 E-cores	4 Zen 5 cores, 4 Zen 5c cores	4 P-cores, 4 LPE-cores	6	6 P-cores, 8 E-cores	2 Zen 4 cores, 4 Zen 4c cores
Threads	20	16	8	12	20	12
Architecture	Raptor Lake	Krackan Point	Lunar Lake	Zen 3	Alder Lake	Phoenix
NPU	✗	✓	✓	✗	✗	✗
Boost frequency (P-cores)	4.6GHz	5.0GHz	5.1GHz	4.3GHz	4.8GHz	5GHz
Boost frequency (E-cores)	3.2GHz	3.5GHz	3.7GHz	N/A	3.6GHz	3.7GHz

Graphics, RAM & storage

Make and model	Intel UHD Graphics 770	AMD Radeon 860M	Intel Arc 140V	AMD Radeon	Intel Iris Xe	AMD Radeon 740M
Video memory	Shared	Shared	Shared	Shared	Shared	Shared
Supplied RAM	8GB DDR4-3200	32GB DDR5-5600	32GB DDR5-8533	16GB DDR4-3200	32GB DDR4-3200	16GB DDR5-5600
RAM slots (free/total)	1/2	0/2	Integrated (dual channel)	0/2	0/2	1/2
Maximum RAM	64GB	64GB	32GB	64GB	64GB	64GB
Supplied storage	512GB	1TB	1TB	512GB	1TB	512GB
Storage expansion	M.2 2280 PCI-E 4	M.2 2280 PCI-E 4	✗	M.2 2242 SATA SSD (Max 1TB), 2.5in SATA HDD (Max 1TB)	M.2 2242 SATA SSD (Max 1TB), 2.5in SATA HDD (Max 2TB)	1 x M.2 2280 PCI-E 4, 1 x M.2 2242 PCI-E 4

Front ports

USB-C ²	1x USB 3.2 Gen 2	1x USB 3.2 Gen 2	1x Thunderbolt 4	✗	✗	1x USB 3.2 Gen 1
USB-A ²	1x USB 3.2 Gen 1, 1x USB 3.2 Gen 2	2x USB 3.2 Gen 2	2x USB 3.2 Gen 1	2x USB 3.2 Gen 2	2x USB 3.2 Gen 2	2x USB 3.2 Gen 1 (one always-on)
3.5mm	✓	✓	✓	✓	✓	✓
Other	✗	Copilot button (front), fingerprint reader (top)	Copilot button (front), fingerprint reader (top)	SD card reader (side)	SD card reader (side)	✗

Rear ports

USB-C ²	✗	1x USB 4	1x Thunderbolt 4	2x USB 3.2 Gen 2	2x USB 4	✗
USB-A ²	1x USB 3.2 Gen 1, 1x USB 3.2 Gen 2	1x USB 3.2 Gen 2, 1x USB 2	2x USB 3.2 Gen 2	1x USB 3.2 Gen 2, 1x USB 2	1x USB 3.2 Gen 2, 1x USB 2	3x USB 3.2 Gen 1, 1x USB 3.2 Gen 2
Ethernet	1x GbE	2x 2.5GbE	1x 2.5GbE	1x 2.5GbE	1x 2.5GbE	1x GbE
HDMI	1x HDMI 2.0	1x HDMI 2.1	1x HDMI 2.1	2x HDMI 2.0	2x HDMI 2.0	1x HDMI 2.1
3.5mm	✗	✗	✗	✗	✗	✗
DC input	✓	✓	✓	✓	✓	✓
Other	1x DisplayPort 1.4	2x DisplayPort 1.4	✗	✗	✗	1x DisplayPort 1.4a

Wireless

Wi-Fi	Wi-Fi 6E	Wi-Fi 7	Wi-Fi 7	Wi-Fi 6	Wi-Fi 6E	✗
Bluetooth	5.3	5.4	5.4	5.2	5.2	✗

Chassis

Size (WDH)	186 x 186 x 36mm	130 x 130 x 34mm	130 x 130 x 34mm	117 x 112 x 38mm	117 x 112 x 49mm	179 x 183 x 37mm
Kensington lock	✓	✓	✓	✓	✓	✓
Weight (as supplied)	1.2kg	653g	531g	579g	594g	1.2kg
Volume (WDH)	1.25l	0.57l	0.57l	0.50l	0.64l	1.2l
Power supply wattage	65W	120W	120W	65W	120W	65W

Bundle

Operating system	Windows 11 Pro	Windows 11 Pro	Windows 11 Pro	Windows 11 Pro	Windows 11 Pro	Windows 11 Pro
VESA mount	✓	✓	✓	✗	✓	✗
Bundled hardware	Stand, wired keyboard and mouse	✗	✗	✗	✗	Wired keyboard and mouse

¹Prices correct at time of going to press but are subject to change. ²USB 3.2 Gen 1 = 5Gbits/sec, USB 3.2 Gen 2 = 10Gbits/sec, USB 3.2 Gen 2x2 = 20Gbits/sec, USB 4 = 40Gbits/sec.



		RECOMMENDED	RECOMMENDED			LABS WINNER
	Lenovo ThinkCentre Neo 50s Gen 5	Minisforum UM750L Slim	Minisforum AI X1 Pro	MSI Cubi NUC AI 1UMG	MSI Cubi NUC AI+	Wired2Fire AMD R8845 Mini PC
	★★★★☆	★★★★★	★★★★★	★★★★☆	★★★★☆	★★★★★
	£714 (£857 inc VAT)	£246 (£295 inc VAT)	£783 (£939 inc VAT)	£708 (£850 inc VAT)	£875 (£1,050 inc VAT)	£500 (£600 inc VAT)
	£523 (£627 inc VAT)	£246 (£295 inc VAT)	£549 (£659 inc VAT)	£708 (£850 inc VAT)	£875 (£1,050 inc VAT)	£500 (£600 inc VAT)
	lenovo.com/uk	minisforum.uk	minisforum.uk	scan.co.uk	scan.co.uk	wired2fire.co.uk
	12XFCT01WWGB2	✗	✗	✗	✗	✗
	1yr RTB	2yr RTB	2yr RTB	3yr RTB	3yr RTB	2yr (5yr labour)
	Intel Core i5-13400	AMD Ryzen 5 7545U	AMD Ryzen AI 9 HX 370	Intel Core Ultra 7 155H	Intel Core Ultra 7 258V	AMD Ryzen 7 Pro 8845HS
	6 P-cores, 4 E-cores	2 Zen 4 cores, 4 Zen 4c cores	4 Zen 5 cores, 8 Zen 5c cores	6 P-cores, 8 E-cores, 2 LPE-cores	4 P-cores, 4 LPE-cores	8 P-cores
	16	12	24	22	8	16
	Raptor Lake	Phoenix	Strix Point	Meteor Lake	Lunar Lake	Hawk Point
	✗	✗	✓	✓	✓	✗
	4.6GHz	4.9GHz	5.1GHz	4.8GHz	4.8GHz	5.1GHz
	3.3GHz	3.5GHz	3.3GHz	3.8GHz	3.7GHz	N/A
	Intel UHD Graphics 730	AMD Radeon 740M	AMD Radeon 890M	Intel Arc	Intel Arc 140V	AMD Radeon 780M
	Shared	Shared	Shared	Shared	Shared	Shared
	16GB DDR5-5600	16GB LPDDR5-6400	64GB DDR5-5600	16GB DDR5-5600	32GB LPDDR5-8533	32GB DDR5-5600
	1/2	Integrated (dual channel)	0/2	1/2	Integrated (dual channel)	0/2
	64GB	16GB	128GB	64GB	32GB	128GB
	512GB	1TB	1TB	1TB	1TB	2TB
	M.2 2280 PCI-E 4, 3.5in HDD (with kit), slimline optical drive (with kit)	M.2 2280 PCI-E 4	1 x M.2 2280 PCI-E 4, 1 x M.2 2280 PCI-E 1	M.2 2242 PCI-E 4	✗	M.2 2242 PCI-E 4
	1 x USB 3.2 Gen 1	✗	1 x USB 4	1 x USB 3.2 Gen 2	✗	1 x USB 3.2 Gen 2
	2 x USB 3.2 Gen 1 (one always-on)	2 x USB 3.2 Gen 2	2 x USB 3.2 Gen 2	2 x USB 3.2 Gen 2	2 x USB 3.2 Gen 2	2 x USB 3.2 Gen 2
	Two (separate mic/phone)	✓	✓	✗	✓	✓
	✗	Reset button	Copilot button (front), fingerprint reader (top), SD card reader (side)	✗	Copilot button, fingerprint reader, microSD reader	✗
	None	USB 4	USB 4	2 x Thunderbolt 4	2 x Thunderbolt 4	1 x USB 3.2 Gen 2
	4 x USB 2	2 x USB 2	1 x USB 3.2 Gen 2	✗	2 x USB 3.2 Gen 2	1 x USB 2.0
	1 x GbE	1 x 1GbE	2 x 2.5GbE	2 x 2.5GbE	2 x 2.5GbE	1 x 2.5GbE
	1 x HDMI 2.1	1 x HDMI 2.1	1 x HDMI 2.1	2 x HDMI 2.1	1 x HDMI 2.1	1 x HDMI 2.1
	✓	✗	✗	✗	✗	✗
	✗	✓	✗	✓	✓	✓
	1 x DisplayPort 1.4, 1 x VGA	1 x DisplayPort 1.4	1 x DisplayPort 1.4, 1 x OCuLink	✗	✗	1 x DisplayPort 1.4
	✗	Wi-Fi 6E	Wi-Fi 7	Wi-Fi 6E	Wi-Fi 6E	Wi-Fi 6
	✗	5.2	5.4	5.3	5.3	5.2
	340 x 291 x 93mm	130 x 127 x 55mm	195 x 195 x 47mm	120 x 115 x 38mm	135 x 133 x 54mm	135 x 127 x 53mm
	✓	✗	✓	✓	✓	✓
	3.9kg	547g	1.4kg	530g	549g	534g
	9.2l	0.91l	1.79l	0.52l	0.97l	0.91l
	180W	65W	135W	120W	120W	120W
	Windows 11 Pro	Windows 11 Pro	Windows 11 Pro	Windows 11 Pro	Windows 11 Pro	Windows 11 Pro
	✗	✓	✓	✓	✓	✓
	Wired keyboard and mouse	✗	2 x SSD heatsinks	Remote (wired) power button	Remote (wired) power button	✗



Shrink fit: how to choose your perfect mini PC

Mini PCs offer more potential than laptops yet more pitfalls than a desktop PC. Here's how to navigate the choices

You'd be forgiven for assuming that it's easier to choose a smaller, simpler computer than it is to buy a full-blown desktop or find the right laptop. Yes, but also no. Mini PCs might not have the expandability of their full-size cousins, and you don't need to worry about screen, trackpad or keyboard quality as you do with a laptop, but there are still plenty of pitfalls.

In fact, with limited scope to upgrade and limited space to do it in, it's more important to get the fundamentals right from the start. Happily, we're here to assist. All mini PCs are small by definition, but many are less than one litre in volume – that's about the size of four to six thick slices of supermarket bread. For a comparison of how the PCs in this test measure up, check out the size graph on p95.

Why go small? First, the obvious: mini PCs weigh less and take up less room than standard computers. They usually have a far smaller footprint than a laptop, and if not you can often mount them vertically. That means they're a great way to reclaim space in the office, or pack a powerful PC into a small bag. Nearly all mini PCs come with a VESA mount, which lets you fix them to the back of most monitor stands: out of sight, out of the way.

This limited size does come at a cost; mini PCs almost exclusively use laptop processors for their lower power consumption and limited heat generation. Similarly, their tight



ABOVE Their tiny size makes mini PCs ideal for a clutter-free desk

Nearly all mini PCs come with a VESA mount, which lets you fix them to the back of most monitor stands: out of sight, out of the way

cases can't deal with the size, power or heat of discrete graphics cards, so you'll almost always end up relying on the processor's integrated chip.

That said, you can add an external graphics card via USB 4, Thunderbolt 4, or OCuLink (as fitted to the Minisforum AI X1 Pro on p87). If you think you might want to add a graphics card, remember that USB 3.2 isn't fast enough.

■ Number crunching

Laptop processors won't slow you down. In fact, they'll probably be significantly faster than those in a desktop PC you might be replacing. Every PC here has more than enough processing power for everyday Windows computing.

However, as you'll see from the performance charts from p94, there's a wide spread of power on offer. If you're likely to run processor-intensive software for coding, video editing or other multimedia applications, be prepared to pay more for lots of power. If you're not, you'll do fine with a more entry-level device

LEFT Most mini PCs can be attached to a VESA mount on a monitor to keep it out of the way

– it will save you money and probably use less electricity, as our estimated running costs graph on p95 shows.

While none of this group of mini PCs is suitable for high settings in the most demanding games, several come with enough power for casual gaming. Three scored more than 3,000 points in 3DMark Time Spy – a commendable result – while all but three could manage a playable 30 frames per second (or close to it) in *Shadow of the Tomb Raider*.

■ AI in the sky?

When we last focused on mini PCs (see issue 363, p78), none came with powerful enough AI capabilities to qualify for Microsoft's Copilot+ PC scheme. Things have moved on, and you can choose from four such models here: Asus' ExpertCenter PN54 and NUC 14 Pro AI, the MSI Cubi NUC AI+ and Minisforum's AI X1 Pro. Two other PCs offer AI acceleration but fall short of Microsoft's 40 trillion operations per second (TOPS) requirement.

It's hard to say definitively how much this matters. In theory, a neural processing unit (NPU) adds highly optimised firepower for AI-enhanced software, particularly in a mini PC that can't otherwise draw on grunt from a discrete graphics processor





(GPU). In a Copilot+ PC, you get useful features such as live captions and live translations, plus Recall, designed to help you find things by describing what you remember about them.

As yet, only a minority of software derives a direct benefit from an NPU. However, you tend to find them on high-end processors, which perform strongly anyway. All of the best benchmark results in this group came from the six mini PCs with an AI processor, but five of these were the most expensive PCs in the test.

■ Upgrade yourself

You can swap out almost anything in a desktop PC, and generally very little in a laptop. Mini PCs are somewhere in the middle. It's usually incredibly easy to pop off the base, where you'll usually have access to dual RAM slots, and often one or more empty M.2 slots. However, mini PCs sometimes have integrated memory that can't be upgraded – three did in this test. Many others (five here) come without any free RAM slots, so you'll need to remove the fitted memory if you want to upgrade. Find the details in our comparison table on p80.

Dropping in an extra SSD is a good way to add fast storage – ten of the 12 PCs on test had at least one free slot. Both Geekom mini PCs use their extra height to offer both an SSD slot and a slot for a 2.5in disk up to 1TB. That's a cheaper way to add storage where speed isn't the priority, but note that in both these computers the spare M.2 SSD slot supports only slower SATA disks, not PCIe ones.

Mini PC processors are usually fixed, so you can't upgrade anything else

ABOVE MSI's Cubi NUC AI+ could fit neatly into a business setting such as retail

internally. Seven of these computers had the necessary USB 4, Thunderbolt 4 or OcuLink ports to add an external graphics card, however.

■ Connections

Almost none of this group is likely to come up short when it comes to connecting peripherals. With the exception of Lenovo's ThinkCentre Neo 50s Gen 5, each had at least one USB 3.2 Gen 2 port, capable of 10 gigabits per second (Gbits/sec) data transfers. That's fast enough to get

the most out of external storage, or support a USB display adapter up to 4K. As mentioned above, seven PCs had at least one Thunderbolt 4 or USB 4 port, with the Minisforum AI X1 Pro the only model

here to also offer an OcuLink port.

With more home routers and office switches offering 2.5GbE network connections, it makes sense to look for a mini PC with a 2.5GbE network port – two-thirds of those tested here have at least one. The standard is 2.5 times faster than regular gigabit Ethernet, which can make a big difference if you regularly transfer big files to and from a network drive, or back up to a NAS.

Remember, though, that you'll need a 2.5GbE switch and other 2.5GbE devices to access the extra speed. And while two 2.5GbE ports

allow for redundancy, load balancing and – potentially – higher speeds, you'll need two cables and two sockets on the switch for every device you connect this way.

Or you could go wireless. We were astonished that the two Lenovo computers tested here came without Wi-Fi, but everything else arrived supporting a minimum of Wi-Fi 6, which offers a theoretical maximum 9.6Gbits/sec bandwidth. Five PCs supported Wi-Fi 6E, which uses the 6GHz band to improve real-world speeds, while three had Wi-Fi 7, with a theoretical top speed of 46Gbits/sec.

You'll need at least a Wi-Fi 6 router to benefit, but – separated from our Wi-Fi 6 mesh extender by one storey – all the Wi-Fi-equipped PCs could sustain at least 500Mbps/sec on large file transfers, with several bursting at up to 700Mbps/sec. At that speed, a one gigabyte file transfers in less than 12 seconds. All the Wi-Fi-equipped PCs also had Bluetooth, with versions ranging from 5.2 to 5.4.

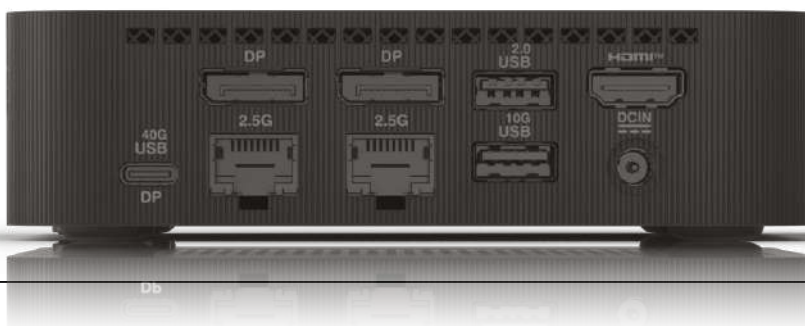
■ Warranty and support

Finally, don't overlook the length of warranty on offer, and the kind of support you're likely to get. The PCs in this test offer from one to three years of cover, while our Labs Winner offers two years on parts and five years' free labour. You can compare many of the brands here in the PC Pro

Technology Excellence Awards (see issue 363, p26), but we don't yet have enough data to include Geekom or Minisforum. You can find extra information about a brand on third-party review sites such as TrustPilot.

We were astonished that the two Lenovo PCs came without Wi-Fi, but everything else supported a minimum of Wi-Fi 6

BELOW Most mini PCs in this test come with an abundance of ports





Asus NUC 14 Pro AI

The NUC 14 Pro AI hits the sweet spot, delivering strong performance for a fair price in a tiny package

SCORE ★★★★★

PRICE £1,000 (£1,200 inc VAT)
from asus.com

Let's skip the preamble: the NUC 14 Pro AI is a cracking mini PC. While it won't out-slug truly top-end NUCs, it's got all the power you need to accelerate enthusiast computing, at a relatively reasonable price. Perhaps that's no real surprise given Asus' pedigree in this market, but this diminutive device still has plenty to set it apart.

The company originally claimed the NUC 14 Pro AI as the world's first AI mini PC. It turned out to be the first of many, but still stands out thanks to Intel's top-end Core Ultra 9 288V processor, which claims 120 trillion operations per second (TOPS) for the whole platform. Some 48 trillion of these come from the NPU, comfortably exceeding the 40 TOPS requirement for a Copilot+ PC. (You can save £360 by opting for a Core Ultra 5 version.)

No surprise, then, to find a Copilot button on the front panel. We have our doubts on exactly how useful this button is – especially if you use the VESA plate to tuck the PC away where it can't be reached. However, an NPU provides a boost in the handful of apps that support one, and we expect their number to grow rapidly over time.

The potent processor is backed up with 32GB of RAM, while storage is covered by a 1TB SSD. Together these ought to provide enough for most users, but if you do need more you'll be out of luck. While it's incredibly easy to unlock and remove this PC's base plate, doing so reveals two M.2 slots already filled by the SSD and wireless card. There are no memory slots; the RAM is integrated onto the main board, and can't be upgraded or removed. On the plus side, it's fast DDR5-8533 memory, which should offer a speed boost over the 5,600MT/sec norm.



At 0.57 litres this mini PC is almost as small as they come, but that hasn't stopped Asus shoehorning in plenty of connectivity. The two front-panel USB-A ports are only USB 3.2 Gen 1, but there's a Thunderbolt 4 socket next to them. You'll find another one of these on the back panel, alongside two USB-A 3.2 Gen 2 ports. There are some compromises: there's only one HDMI port, and a single

2.5GbE socket – possibly a limitation in extremely data-intensive applications.

Still, there's room for the AI button, a 3.5mm audio port and a fingerprint reader on top.

Switch on the NUC 14 Pro AI and there's the welcome sound of... silence. After a brief spin-up at boot, the fan spends most of its time running so quietly that you can't hear it. That makes this a fantastic companion in a quiet home office setup, where its cooling system barely intrudes, reaching only a restrained whirr when gaming or running benchmarks. The flip side is that this PC does get warm, even during relatively everyday jobs such as applying Windows updates.

It's when running demanding applications that this computer

ABOVE Despite being among the smallest PCs on test, this is a strong all-rounder



LEFT Despite its power, the NUC 14 Pro AI runs almost silently

BELOW The rear panel features two USB-A 3.2 Gen 2 ports



really begins to impress. It's not the fastest mini PC in the round, but it punches well above what you might expect given its size. For instance, the Asus NUC 14 Pro AI showed the third best PCMark 10 performance in this group; its 2,807 single-core score in Geekbench 6 also placed it third fastest; and its single-core return of 124 in Cinebench 2024 is the best we've yet seen from a mini PC. The Intel chip's multicore performance was more mixed. It recorded an impressive 11,116 score in Geekbench 6, but was comfortably outpaced in Cinebench 2024, particularly by rivals with high-end Ryzen chips and their numerous cores.

Like the other mini PCs in this test, the NUC 14 Pro AI makes do with integrated graphics, but Intel's Arc 140V accelerator is more potent than you might expect. This PC recorded comfortably the best result here in 3DMark Time Spy, and served up playable frame rates in *Shadow of the Tomb Raider*, even with the highest detail settings. Perhaps most importantly, there were no dropped balls – this PC is quick across the board, and up for almost anything.

You can buy cheaper mini PCs, but if you're after strong all-round performance, the Asus NUC 14 Pro AI makes a strong case for itself. It's fast in office, multimedia and gaming benchmarks, offers good connectivity, fits into a tiny space, and won't keep you awake if you leave it running overnight. It's a great choice for demanding users who need convincing performance, and as Asus is aiming this at business rollouts you may be able to negotiate a significant discount on the price we quote if you buy in volume.

Geekom A5

Cut-price PCs always force some compromises, but the Geekom A5 navigates them deftly

SCORE ★★★★★

PRICE £224 (£279 inc VAT)
from geekom.co.uk

In a labs test featuring plenty of highly specified PCs, it's interesting that many of the standout models were the ones geared towards value. Take the Geekom A5. Not only is it one of the cheapest devices here, it's also one of the most affordable mini PCs on the market.

To Geekom's credit, this PC's modest price is only reflected in its specifications to a limited degree. Sure, it packs a relatively aged AMD Ryzen 5 7430U processor, but it's paired with 16GB of RAM and a 512GB SSD – that's really not bad for the money. Perhaps more impressively, the A5 benefits from the same three-year warranty that Geekom provides with all its computers. That's a great reassurance if money's tight, and you want to spend it on something that will last.

Not everyone will love the A5's case colour: a strange kind of gold with a purplish tinge. It's got massive grilles on each side, too. It's hard to find fault with other aspects of its design, though. There are five USB ports, split between USB-C and USB-A, four of which are USB 3.2 Gen 2. You also get two HDMI ports and an SD card reader.

One sign of its low price is a single network port, ruling out some more advanced usages for such mini PCs, but that port is rated at 2.5GbE: in partnership with a suitably quick switch or router, and other 2.5GbE devices, you could send about 270MB of data between them every second. That said, Wi-Fi has become far better in recent years, and this was one of several mini PCs happy to transfer large files at several hundred megabits per second. It sustained more than 70MB per second when transferring large files on our Wi-Fi 6 network, enough to outpace a middling fibre broadband connection.



Things get even better when you open the case. Both memory slots are full, but you can replace the provided modules for a maximum 64GB. Unusually, this mini PC's comparatively tall case can accommodate a 2.5in SATA drive, while there's further expansion via a spare M.2 2242 slot; note that this is also SATA, rather than PCIe. Together they let you add up to 2TB of further storage. One final thing to note is that the provided power supply is about as small as they come.

Give the Geekom A5 anything too demanding and you'll be reminded of its budget status – it generally posted among the slowest benchmark scores in this test. In particular it was some way off the pace in the multicore sections of Geekbench 6 and Cinebench 2024. That said, its 5,465 points in PCMark 10 isn't exactly embarrassing; four other PCs here scored below 6,000.

Things were a little more clear-cut in 3DMark Time Spy, where the Geekom A5 could muster a score of only 1,300. While three other mini

ABOVE The Geekom A5 is a fantastic general-purpose PC for the money

LEFT The "gold with purplish tinge" colour scheme will likely split opinions

BELOW Four of the five USB ports are USB 3.2 Gen 2

PCs were slower, pushing the Geekom A5 to mid-table status, they were equally unsuitable as gaming machines. This PC doesn't have the USB 4, Thunderbolt 4 or OCuLink connection you'd need to add an external graphics card, so you're stuck with its humdrum 3D performance. The A5 also logged among the least impressive transfer rates in the CrystalDiskMark 8 sequential read and write tests.

However, all this is to partly miss the point: the A5 is plenty fast enough for everyday computing, even managing a playable 28fps running *Shadow of the Tomb Raider* at the lowest detail settings. You'll certainly hear its fan on any processor-intensive workload, but it never becomes especially intrusive or irritating. And while its SSD isn't the fastest, it could still write and read above 3GB/sec – that's an awful lot of data in a hurry.

Look at the A5 as a pint-sized, general-purpose computer for the home or office and you're unlikely to be disappointed. It's plenty powerful enough for office admin roles, and won't get bogged down unless you've lost count of your browser tabs at the moment somebody wants a Teams call. In the home, it's up for anything except gaming, and even then it will run older titles if you don't mind compromising on resolution or detail.

Cheap isn't always cheerful, but in the A5, Geekom has found an excellent balance between affordability and usability. If you're after a cheap but capable mini PC, it's a very close call between this and the Minisforum UM750L Slim. We'd take the latter, but only just.





Minisforum UM750L Slim

This brilliant mini PC offers mid-range speeds for a price that looks like a typo: it's sensational value

SCORE ★★★★★

PRICE £249 (£299 inc VAT)
from minisforum.uk

Let's not talk about the price of this mini PC – at least not yet. Minisforum's UM750L Slim packs 16GB of memory and a 1TB SSD. It's powered by an AMD Ryzen 5 7545U processor that placed it broadly lower-middle in our benchmarks, and produced playable frame rates in *Shadow of the Tomb Raider*. Now consider that it's the second-cheapest PC here, costing half the price of its mid-range rivals, and look at those specs and benchmarks again. Surely some mistake?

Fortunately not. The UM750L Slim's processor might be a couple of years old, but it's still a fine mid-range choice for any general-purpose PC. Here it's partnered with dual-channel onboard RAM clocked at 6,400MT/sec, giving a slight lift above the 5,600MT/sec you might expect to find. That's a good foundation for any general-purpose PC, particularly when partnered with a generous SSD – we'd expect to settle for 512GB at this price. No, you don't get an NPU, but frankly you'd be mad to expect one.

If there's a catch, it's certainly hard to spot. The UM750L Slim has two USB-A 3.2 Gen 2 ports on the front, and two USB-A 2 slots at the rear, where you'll also find a USB-C 4 port, DisplayPort and HDMI. There's only one network socket, but it's 2.5GbE. You will have to make do without either a card or fingerprint reader, though.

Of course, there are some compromises. Minisforum says the maximum RAM available is 32GB, but as it's onboard you have to buy it that way. Open up this PC's case and there's no slot to add more – worth bearing in mind given that 16GB is the



minimum we now recommend for Windows 11 computing. There is a free M.2 2280 PCIe slot, though, allowing you to add up to another 1TB of storage. This, and the supplied drive, are protected by a heatsink with active fan cooling.

It's also worth mentioning that this isn't the smallest device, measuring almost twice the volume of the tiniest examples in our test.

It comes in a slightly cryptic case. The clue to gaining entry is in the couple of spare rubber feet that ship in the box – you'll need to pry all four off to get at the screws underneath, then carefully lever the case open at the point marked by an arrow. While it's nice to have the reassurance of the extra feet, we refitted all four originals without trouble.

The Minisforum UM750L Slim didn't drop any balls across our benchmarks. Geekbench 6 scores of 2,511 (single core) and 9,010 (multicore) are more than respectable for a mini PC, while a PCMark 10 score of 5,905 is also very fair. While it couldn't slug it out against the NUCs

ABOVE The UM750L Slim offers decent performance for a ridiculously low price



LEFT It may be a little larger than other mini PCs, but its power consumption is low

BELOW Two USB-A 3.2 Gen 2 ports on the front back up plenty of ports on the rear

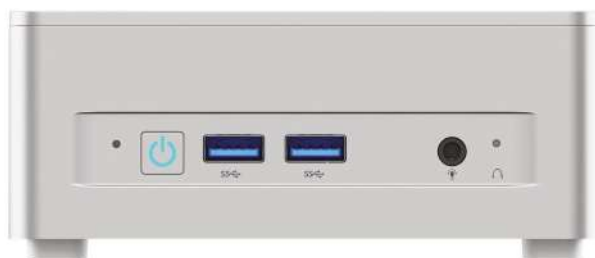
and other high-end examples we looked at, it outperformed several PCs costing more, notably the Acer Veriton N6 VN6710GT.

We wouldn't buy this mini PC for gaming, but it isn't an awful choice if you just wanted to dip into older releases. Only five other computers here had it beat in *Shadow of the Tomb Raider*, while six were ahead of its modest 1,796 score in 3DMark Time Spy.

One advantage of choosing a computer with limited brain power is that it uses less electricity. The UM750L Slim recorded the joint lowest energy consumption here: we estimate its five-year running costs to be only £32. A happy flip-side of that is that it produces comparatively little heat or noise, so this computer would be easy to live with, even in a quiet home office.

All of this makes the Minisforum UM750L Slim a close match for Geekom's A5. While the latter offers an extra year's warranty and a little more in terms of upgradability, the UM750L Slim has it soundly beaten for both performance and storage space. Neither brand is well known enough in the UK to gain a *PC Pro* reader rating for reliability, although both get a decent four stars or more on TrustPilot, suggesting their customers are typically satisfied. Still, business buyers in particular might be swayed by a more trusted brand, even if that does mean paying more.

For everyone else, the Minisforum UM750L Slim is a very tempting bargain. It offers ample everyday power in a small and quiet package, for surprisingly little money. That's pretty much the ideal for a budget mini PC.



Minisforum AI X1 Pro

An amazing spec and great performance at a price that undercuts market leaders – and it's stylish, too

SCORE ★★★★★

PRICE £783 (£939 inc VAT)
from minisforum.uk

While Minisforum's UM750L Slim courts the lower end of the market, its AI X1 Pro is focused on much more demanding users. It's a lovely looking thing, too. Though some way bigger than the smallest mini PCs, its alloy case has no vents on the front three sides, and little clutter. It would probably attract admiring glances in an office or living room, shortly followed by questions about the little-known brand, but let's park that for the moment.

Spec spotters will be delighted by what this PC has to offer. The range starts at £659 inc VAT for a barebones system without RAM or disk, but we're testing the £939 version fitted with a very handy 64GB of memory, alongside a 1TB SSD bearing Windows 11 Pro. The range is powered by AMD's Ryzen AI 9 HX 370 processor, among the most powerful CPUs you can squeeze into a mini PC. Its 50 trillion operations per second (TOPS) NPU qualifies this as a Copilot+ PC – you even get a button to remind you.

The high points don't end there. The AI X1 Pro offers two USB-A 3.2 Gen 2 ports and a single USB-C 4 connection on its front panel. There's an SD card reader to the right and a fingerprint reader on top. At the back you'll find another USB4 port, another USB-A 3.2 Gen 2 socket, and dual 2.5GbE ports. What's more, this is the only PC here to offer an OCuLink connection, useful if you want to add a discrete graphics card later. If you're using the integrated graphics, you can connect monitors via HDMI, DisplayPort or the USB-C ports. Talking of connections, the AI X1 Pro is bang up to date when it comes to wireless, offering both Wi-Fi 7 and Bluetooth 5.4.

With that kind of firepower, we were expecting this mini PC to excel across our benchmarks, and it was



indeed dominant. Its 2,890 Geekbench 6 single-core score is impressive enough, but it notched up 14,988 on the multicore test – both are the best results we've had from a mini PC. While its single-core score in

Cinebench 2024 didn't lead this group, its colossal 1,258 in the multicore test is again the fastest we've seen. Throw in 7,625 in PCMark 10, and it's clear this is a brutally quick PC.

The AI X1 Pro didn't have things all its own way, though. Although it managed the highest frame rates in *Shadow of the Tomb Raider*, its 3,657 in 3DMark Time Spy fell behind Asus' NUC 14 Pro AI. Still, only one other computer in this group broke the 3,000-point barrier.

Despite its comparatively big 1.8-litre volume, this PC comes with a VESA mount, so you can tuck it out of sight behind your monitor. It will be hard to reach its fingerprint sensor or Copilot button if you do, though. There's also a vertical stand, in which mode it looks much like a wireless router. In the box you'll find two

ABOVE The AI X1 Pro is a great choice for power-hungry users



LEFT A vertical stand lets you position the PC upright like a router

spare SSD heatsinks, ready for you to get the most out of the two free M.2 2280 slots inside. It's worth noting that this computer supports two disks at PCIe 4x, but the third will drop to PCIe 1x, limiting that SSD's maximum transfer speeds.

The Minisforum AI X1 Pro might look great, but it isn't so easy to work inside. Opening the case involves removing four heavily recessed screws that proved out of reach for our usual powered screwdriver. There's a fifth screw under a sticky rubber cover. Undo all these, prise the base off and you'll need to remove a further eight – yes, eight – screws before you can carefully lift up the power assembly. Underneath you'll find the two empty M.2 slots and two occupied RAM slots.

For some, Minisforum's relatively unknown status might be the elephant in the room. It's one thing spending £300 with a manufacturer you haven't heard of, but another blowing over £900. Minisforum does back up its PCs with a two-year warranty, and its Trust Pilot rating suggests satisfied customers. If you have reservations, consider opting for a better-known brand, but be prepared to get much less for your money – because in that regard the AI X1 Pro is high-on unbeatable.

BELOW The OCuLink port on the rear lets you add a discrete graphics card



Wired2Fire AMD R8845 Mini PC

Wired2Fire's AMD R8845 Mini PC offers simply ridiculous specs and performance for the money

SCORE ★★★★★

PRICE £500 (£600 inc VAT)
from wired2fire.co.uk

British PC manufacturer Wired2Fire was a late entrant to this test, kindly rushing us its AMD R8845 Mini PC at short notice. Like the Geekom and Minisforum systems, it's aimed at consumers rather than businesses, with no management features and Windows 11 Home. Nor will you find luxuries such as a fingerprint or memory card reader on its sides. As a result there's something pleasingly uncluttered about the design and at 0.9 litres it's also very small – but not tiny.

For the money, this mini PC has an eye-watering specification. It's powered by an AMD Ryzen 7 8845HS processor offering eight cores and 16 threads. It's a potent choice, with a 5.1GHz boost speed and onboard NPU contributing 16 TOPS. While that falls short of the Copilot+ PC bar, it will still come in useful, especially when Wired2Fire includes a generous 32GB of RAM and a massive 2TB SSD.

That's pretty impressive, but should you need to upgrade there's an empty M.2 2242 slot inside for another SSD. This PC will accept up to a huge 128GB of RAM, but you'll need to pull out the two supplied 16GB modules first. It's easy to get inside via four screws at the corners. While it seems as though these should live under rubber feet, our sample didn't have them – it was the only PC here that could slide about on a desk.

The Wired2Fire AMD R8845 Mini PC offers a decent range of ports. There's USB-C 3.2 Gen 2 front and rear, with a further two USB-A 3.2 Gen 2 sockets at the front. The rear panel's two USB-A ports are only USB 2, which is fine if you're connecting printers or

peripherals, but not ideal if you have lots of demanding disks or card readers to hook up. You'll also find single 2.5GbE, HDMI and DisplayPort connections, so most uses are covered.

It's not until you get into Windows that this mini PC begins to really impress. With power to burn it feels as fast and fluid as you'd want, and the AMD R8845 Mini PC underlined this with a stonking set of benchmark results. Perhaps surprisingly with such a fast clock, it didn't especially stand out on single-core tests, but this PC posted the third fastest result in both Geekbench 6 and

Cinebench 2024's multicore sections. Its 6,856 points was also fourth fastest in PCMark 10.

While this isn't a gaming computer, it's not at all bad for a mini PC using integrated graphics. Its 3,263 points in 3DMark Time Spy placed it third in this test, while again it was third quickest in *Shadow of the Tomb Raider*, posting playable frame rates even at

ABOVE Wired2Fire's AMD R8845 Mini PC is a powerful computer with few compromises



LEFT We could find very little to criticise about this superb PC

BELOW The PC is well endowed with all the ports you'll likely need



the highest detail settings. All that would be impressive enough in isolation, but this is only the eighth most expensive computer here.

With high performance and a low price, it's tempting to assume there are compromises to be found, but the AMD R8845 Mini PC feels as though it's been specced out by enthusiasts. Rather than generic components, it's fitted with Crucial RAM and a Kingston Fury SSD, which delivered the fastest read and write results in the group by some margin.

Indeed, other than the missing feet, just about the only thing we could critique about our sample was the fan noise. It's fine at idle, easily blending into the background of a quiet home office. However, it doesn't take much load before the fan steps up, at which point something about the quality of the noise makes it a touch invasive. Happily it doesn't become much more so, even at full chat.

If you can cope with a little noise, the Wired2Fire AMD R8845 Mini PC will feel like a revelation. Here's a sub-one litre PC for £600 that can live with – and in some cases beat – range-topping models from the major brands. With a generous base spec it's unlikely you'd ever want to upgrade, but there's scope for it if you do.

The idea you can buy an affordable computer this small, with this much power, and hide it behind your monitor is incredible. Unless you absolutely must have a gaming rig, or a PC meeting the Copilot+ PC minimum, the AMD R8845 Mini PC is all the computer you need in a dinky, affordable package.



Acer Veriton N6 VN6710GT

Acer's Veriton is a business-focused mini PC, but with only 8GB of RAM it failed to set our benchmarks alight

SCORE ★★☆☆

PRICE £420 (£504 inc VAT)
from [ballicom.co.uk](https://www.ballicom.co.uk)

If you want a sensible mini PC for general business use, the Acer Veriton N6 VN6710GT is a fine choice. It's built in a squat, square metal case, featuring recycled plastics made from post-consumer waste. The ports are colour-coded, it has cable clips, a vertical stand and a monitor mount – which also doubles up for fixing the PC to a wall. Add in a wired keyboard and mouse as standard, and this is a decent package for getting a new staff member up and running – all you need to do is add a monitor.

But while the VN6710GT ticks all the right boxes for sustainability



and practicality, it's not so exciting when it comes to the details. We tested a model based on Intel's Core i5-13500T, a mid-range processor that's beginning to eye up its pension package. It doesn't help that it's paired with only 8GB of RAM; we generally don't recommend less than 16GB to get the best out of Windows. It's also debatable whether 512GB is enough storage these days, as highlighted by the fact we had less than 200GB free after installing our benchmarks.

It takes a single screw to remove this PC's top panel, revealing a spare memory socket along with an empty second M.2 2280 slot. The only other thing of note is a tamper switch, which could be useful if you don't want employees poking about or

ABOVE An ancient CPU and lack of RAM hold the Veriton back

BELOW The squat metal case features recycled plastics



pilfering RAM. The Veriton VN6710GT has a single USB-C 3.2 Gen 2 port on the front, and a mix of Gen 1 and Gen 2 USB-A ports front and rear.

With a generally underwhelming specification, it's no surprise that the Veriton VN6710GT failed to shine in our

benchmarks. It managed reasonable results across typical productivity tests, such as a decent 2,289 points in Geekbench 6's single-core section.

It also impressed with fast 6,509MB/sec sequential read speeds in CrystalDiskMark 8. However, it wasn't so hot in the disk write test, managing a mid-table 3,984MB/sec. Most mini PCs here outpaced it in PCMark 10, while its integrated Intel UHD Graphics 770 were nowhere for gaming. It didn't even meet the minimum memory requirements to run Cinebench 2024.

This is by no means a bad mini PC, especially if you just want a no-fuss addition to the office. However, you needn't spend much more to get additional RAM and storage, and far greater performance, too.

Asus ExpertCenter PN54

Packs a huge amount of performance into a truly tiny space, so it's a shame about the price

SCORE ★★☆☆

PRICE £1,145 (£1,374 inc VAT)
from [amazon.co.uk](https://www.amazon.co.uk)

At well over £1,000 – even before you factor in VAT – Asus' business-focused ExpertCenter PN54 is the most expensive mini PC in this group. It's also one of the smallest, yet it pulls off the impressive trick of being one of the most powerful. For the most part that's down to the AMD Ryzen AI 7 350 processor at its heart. At the time of testing, this was towards the top end of mobile processors. Based on AMD's 4nm Zen 5 architecture, it features 8 cores, can boost at up to 5GHz, and with a 50 trillion operations per second (TOPS) NPU, helps qualify the PN54 as a Copilot+ PC.

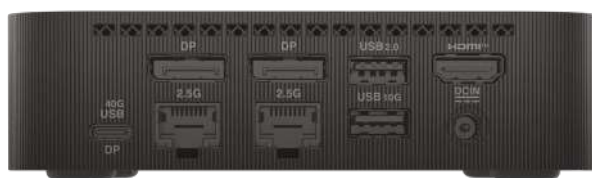


Asus has sensibly given the ExpertCenter PN54 32GB of RAM and fitted a 1TB SSD, which ought to be plenty to get the most out of it. Other spec highlights include a USB-C 4 port at the rear, a total of three USB-A 3.2 Gen 2 ports and two 2.5GbE network sockets. Somehow Asus has also found room for HDMI and two DisplayPort connections on the rear panel – quite a feat on a tiny 0.57-litre PC.

Like most mini PCs, you can mount the PN54 behind a monitor with its supplied VESA plate, although doing so will make it hard to press the

ABOVE The Asus ExpertCenter is tiny, powerful – and pricey

BELOW The selection of ports is impressive for such a small PC



Copilot button or find your way to the fingerprint reader. It's also worth mentioning that this PC's power supply is almost half as big as the computer itself.

Show it some benchmarks and the ExpertCenter PN54 doesn't mess about. With no discrete graphics card, it couldn't manage buttery frame rates in 3DMark Time Spy, but it scored a reasonable 2,993 points and delivered a playable 31fps at the highest detail settings in *Shadow of the Tomb Raider*. It monitored everything else, with particularly impressive multicore scores of 908 in Cinebench 2024 and 13,840 in Geekbench 6.

That means we can put a big tick mark against "great performance" – and "great packaging", with the latter enhanced by simple access for any upgrades. Open the base and you'll find both memory slots full – a shame if you're planning an upgrade to the 64GB maximum – with a free M.2 2280 slot for more storage. The only other thing of note is a small amount of fan noise, but nothing to trouble you except in a quiet home office.

This is an impressive mini PC, but it's pricey even when you factor in Windows 11 Pro rather than Home. We only hope that price will drop. In the meantime, our Labs Winner runs it close for performance at half the price.

Geekom Mini IT12

Quiet, compact and relatively upgradable, the Mini IT12 puts value ahead of outright performance

SCORE ★★★★★

PRICE £416 (£499 inc VAT)
from geekom.co.uk

At first glance you'd be forgiven for thinking there's not much remarkable about the Geekom Mini IT12; it certainly doesn't stand out in our performance tables. It's quite a cheap mini PC, though, with the range starting at only £379 inc VAT. The example we're testing costs £120 more, and comes with an impressive 32GB of RAM and a 1TB SSD. The processor isn't quite so exciting: an Intel Core i7-1280P, which launched more than three years ago.

Still, you can't have everything on a budget, and the Mini IT12 follows Geekom's tradition of offering plenty of ports and good upgradability. Clustered around this dinky, 0.64l



device you'll find two USB-C 4 ports, three USB-A 3.2 Gen 2 ports and a single USB-A 3.2 Gen 1 socket. There are also two HDMI ports along with an SD card reader. Power users might bemoan the single 2.5GbE network connection and lack of a fingerprint reader, but you do get Wi-Fi 6E and a 3.5mm audio jack.

There's a reason the Mini IT12's case is a little taller than the norm. Open it up and you'll find its two memory slots are already full; remove the supplied modules and you can upgrade to a 64GB maximum. There's also space for an M.2 2242 SATA (not PCIe) SSD, and a 2.5in SATA drive.

ABOVE The Mini IT12 is relatively upgradable for a mini PC

BELOW There are plenty of USB ports dotted around the case



Look again at those performance figures and the Mini IT12 starts to really come good. Its ageing processor left it some way off the top, particularly on processor-stretching tasks such as the Geekbench 6 single-core test. However, the same benchmark placed it mid-table for multicore

performance, and this PC was far from disgraced in Cinebench 2024's single-core evaluation. It even – just – produced a playable frame rate at the lowest detail settings in *Shadow of the Tomb Raider*.

While it's not a gamer's PC or a particularly good choice for power users, the Geekom Mini IT12 makes a lot of sense for enthusiasts or businesses looking for a compact and solid PC at a fair price. It's helped in this regard by the fact you can't hear it unless it's busy, making the IT12 very easy to live with. It may not be remarkable, then, but it is great value, particularly given that it's backed up by a three-year warranty.

Lenovo ThinkCentre M75q Gen 5

A mini PC that screams business, the ThinkCentre M75q Gen 5 is capable but fails to stand out

SCORE ★★★★★

PRICE £551 (£661 inc VAT)
from lenovo.com

Lenovo's ThinkCentre M75q Gen 5 is aimed at business use, and it looks like it. It comes in a sensible black metal case with a sensible range of ports, is available with a range of sensible options, and has a three-year on-site warranty. That said, there are some silly omissions: it doesn't have a fingerprint reader, and the standard model doesn't come with Wi-Fi. At the time of our test, Lenovo was bundling a free keyboard and mouse, but they were the sort of cheap peripherals you wouldn't wish on anyone.

While the line starts at £509, we're testing the mid-range, AMD Ryzen 5 8500GE version. This has a single 16GB



memory module, leaving space for an easy upgrades. There's also a 512GB SSD, which is stingy at this price. Lenovo will pimp your M75q with anything from Ubuntu to a VGA port, and prices are reasonable: you can add Wi-Fi, a vertical stand and VESA mount for a total of £40, for example, although at least two of those things should be standard.

The M75q Gen 5 has a single USB-C port, but it's only USB 3.2 Gen 1. There are five USB-A variants, only one of which is a USB-A 3.2 Gen 2 port. Not only is there just one network port, it's 1GbE. Connectivity perhaps isn't this computer's strength, then – at least there's room inside to add a couple of extra NVMe SSDs.

This mini PC's reasonable processor kept it honest in most of

ABOVE The M75q is squarely aimed at business users...

BELOW ...and it certainly fits into tight spaces



our benchmarks, where its mid-table scores show it's plenty quick enough for everyday office work. Notably, however, it couldn't significantly outpace the Minisforum UM750L Slim, which costs less than half as much. Then again, we wouldn't even think about rolling

that out to a business, whereas the ThinkCentre is born for such environments due to its far greater manageability. If you're interested in after-hours gaming, though, look elsewhere: this PC inched to the third lowest score in 3DMark Time Spy, and couldn't reach playable frame rates in *Shadow of the Tomb Raider*.

The biggest argument in favour of the Lenovo ThinkCentre M75q Gen 5 is for large rollouts where you have specific needs, such as VGA ports. Still, it doesn't offer a lot of bang for your buck, being behind the curve for Wi-Fi and wired networking speed, too. In today's competitive market it's easy to get more for significantly less – the only compelling reasons to choose this PC are for its recognisable brand and strong warranty.



Lenovo ThinkCentre Neo 50s Gen 5

Bigger than true mini PCs, the ThinkCentre Neo 50s Gen 5 is a reminder why small is beautiful

SCORE ★★☆☆

PRICE £714 (£857 inc VAT)
from lenovo.com/uk

We wanted to include one or two slightly larger PCs in this test to see if it was worth trading space for more performance and features. Enter the Lenovo ThinkCentre Neo 50s Gen 5, a midi PC weighing nearly 4kg and taking up nine litres of space. That's still compact by PC standards, but you get the advantage of an integrated power supply – and more room for useful extras.

Not that you get them at this price. We tested a mid-range variant, powered by Intel's 13th generation Core i5-13400 desktop processor. In its base configuration it comes with



16GB of memory and only 512GB of storage, no Wi-Fi, no optical drive, and a one-year warranty – that really doesn't look great for £714 exc VAT.

The Neo 50s Gen 5 doesn't make the most of its extra space. It's easy to get into the case, but we hated working inside it: it's almost impossible to access the memory slots thanks to an overhanging drive cage. Not that you can just drop in a standard slimline optical drive without the necessary brackets; these are "free", but only if you pay Lenovo to fit it for you.

ABOVE The Neo 50s Gen 5 is bigger than the other PCs here

BELOW Sadly, Lenovo doesn't make the best use of the extra space



It doesn't offer significantly more ports than the best mini PCs; indeed, Lenovo's own M75q Gen 5 almost has it matched front and back. Its CPU might be for desktops, but it's a couple of years behind the curve, and its integrated graphics aren't much cop. If you're interested in gaming, you'll need to add a low-profile graphics card yourself; gaming performance was awful without one.

Things were better in our general computing benchmarks, but we'd expect more at this price. This PC didn't excel on a single test, and was blown into the weeds by several cheaper, smaller devices. Its disk performance compared particularly badly, and its power consumption was comfortably the highest here.

All of which leaves us wondering who this PC is for. It offers Windows 11 Pro and some upgradability, but you pay plenty for the privilege. It also offers big-name reassurance, particularly for businesses, but the standard warranty is only one year. Everyday performance is fine, but nothing you can't get from rivals costing a fraction of the price. At the same time, by going bigger you lose the convenience of a PC you can hide behind your monitor. Try as we might, we can't think of a compelling reason to choose the Neo 50s Gen 5.

MSI Cubi NUC AI 1UMG

MSI's business-friendly mini PC sits in a very competitive space, and unfortunately it doesn't come out on top

SCORE ★★☆☆

PRICE £708 (£850 inc VAT)
from scan.co.uk

MSI's Cubi NUC AI 1UMG sits at something of a sweet point in the mini PC market. As such, it's in good company, lining up broadly against the Asus NUC 14 Pro AI and Minisforum AI X1 Pro. However, straight away it's at a disadvantage: unlike those rivals, the NPU in its Intel Core Ultra 7 155H processor offers only 11 TOPS, short of the requirements for a Copilot+ PC.

At this price we'd hope for more than 16GB of RAM. Still, the 1TB SSD is welcome – this one performed particularly well in CrystalDiskMark's sequential read test. It's also easy to remove the four screws and get at the Cubi's internals. Here you'll find a free memory slot,



making it simple to add another 16GB module, or bin the existing one for a 64GB maximum. There's also a spare M.2 PCIe slot, although it's for shorter 2242 cards.

There's no fingerprint reader, but MSI does include a power button on a cable – useful if you mount this behind a monitor. Despite a tiny 0.52-litre volume it packs in the ports, offering three USB 3.2 Gen 2 ports, split between a single Type-C

ABOVE The Cubi NUC AI 1UMG isn't as powerful as its price might suggest

BELOW There are plenty of ports, despite its small size



version and two Type-A. MSI also provides two Thunderbolt 4 ports on the back panel, along with two HDMI ports and two 2.5GbE network sockets.

Turn on the Cubi NUC AI 1UMG and you'll immediately notice its fan noise. While not loud, it's constant, making this one of the

noisiest computers in this test. We wouldn't mind so much if it was explained by blistering performance, but it's not. While never slow, it was trounced by its two similarly priced rivals, and our Labs Winner, which costs more than £200 less. In fact it wasn't convincingly faster than the Minisforum UM750L Slim, which is almost three times cheaper.

Without especially strong overall performance, and lacking AI potential to make up for it, that leaves the MSI Cubi NUC AI 1UMG looking out of its depth at this price point. It's not a bad mini PC, and you do get Windows 11 Pro, but it gives away too much when you can buy faster Copilot+ rival PCs for a similar price.

MSI Cubi NUC AI+

MSI's Cubi NUC AI+ is a pricey, high-end AI mini PC based on Intel's Lunar Lake chips – for good and bad

SCORE ★★★★★

PRICE £875 (£1,050 inc VAT)
from scan.co.uk

The MSI Cubi NUC AI+ has all the ingredients for a high-end Copilot+ PC. It's built around an Intel Core Ultra 7 258V processor rated at 115 TOPs overall, with the NPU contributing a cool 47 trillion ops per second – that's good enough for a Copilot button, even if we're still not sure why you'd want one. In fact, you needn't use it or the built-in fingerprint reader at all: you can VESA-mount this PC out of sight, and use the supplied stick-on power button extension to turn it on.

This mini PC is comparatively tall, giving it a total volume just shy of one litre. That means there's loads of space for upgrades, so it's all the more disappointing to find there are



no free slots inside. You're stuck with the 32GB of onboard RAM and the supplied 1TB SSD. That said, the integrated memory is clocked at 8,533MT/sec, substantially above the 5,600MT/sec norm.

This is one of few mini PCs that puts a combined power button/fingerprint sensor and microSD card slot on the front panel for convenience. Here, you'll also find

ABOVE The Cubi NUC AI+ is a decent mini PC, but cheaper models perform better

BELOW The relatively tall case means lots of room for connectors



an audio socket and a couple of USB-A 3.2 Gen 2 ports, with two more to be found at the rear. With two Thunderbolt 4 sockets, an HDMI output and a pair of 2.5GbE ports, connectivity certainly isn't a problem.

But, for an expensive PC, performance is. We experienced repeated delays and failures trying to get Windows fully up to date on our sample, resetting it twice before pausing the problem update. Even freshly reinstalled, it was much less impressive than we'd hoped in our benchmarks. The Cubi's 2,719 single-core score on Geekbench 6 was strong, while it managed an excellent 121 in the Cinebench equivalent. However, its multicore score in Geekbench was less convincing, while it could muster only a limp 476 in Cinebench – a characteristic of Intel's Lunar Lake chips with their lack of threads. At least gaming performance was more positive, with a fair 3DMark Time Spy result and decent frame rates in *Shadow of the Tomb Raider*.

It's not enough at this price, however. Four PCs in this group showed the Cubi NUC AI+ a clean pair of heels across the balance of our tests, and three of these cost less. As such, it's hard to get too excited about this mini PC.

Why no Chromeboxes?

We discover if there's life in mini PCs running Chrome OS

We had hoped to include a couple of Chromeboxes – mini PCs that run ChromeOS – in this test. Surely their simplified software would be the perfect match for compact, simple hardware? However, it quickly became clear that they were a non-starter. Only Acer was able to send us a current Chromebox, and we quickly realised the rest of the group would eat its breakfast, lunch and dinner before flushing its head down the toilet.

For some users, ChromeOS is the perfect antidote to a Windows experience that remains bloated, slow and overkill for lightweight tasks like working in office suites. Chromebook sales peaked during the pandemic, but according to the latest figures from Canalys they've dropped back significantly to roughly 17 million units in 2024, against around 200 million Windows-based notebooks.

But if Chromebooks are a niche choice, Chromeboxes are micro-niche. We couldn't find Chromebox-only sales figures, as they get lumped in with other ChromeOS devices, but while researching this Labs Google's own ChromeOS website could find only one Chromebox to showcase, and that launched in January 2023. Acer did announce two new models at IFA (see p32), but it's hardly a thriving scene.

Chromeboxes' apparent decline is perhaps surprising when so many businesses now use Google Workspace – many sources say it has 50% or more of the market, while Google itself claimed three billion users as long ago as 2021 (tinyurl.com/374workspace). Of course, you don't need ChromeOS to use Workspace, but it's perfect if all you're doing is footling around in office apps on a browser.

BELOW Acer's Chromebox was no match for the other mini PCs in this test



And for many, that's the problem – ChromeOS isn't great for much else. While many ChromeOS devices support Android apps, these are usually optimised for phones and tablets. You don't have the same freedom Windows gives you to buy and install whatever you want, or Linux's wide range of open-source alternatives. That makes ChromeOS restrictive: simple and lightweight, but lacking killer apps for coding, multimedia and indeed almost anything other than office work.

In this context it's not hard to see why Chromeboxes haven't set the world alight. Schools might be happy with lightweight, browser-based computing, but businesses want the freedom to run a wider range of software, especially in a workstation setup. Happily, the mini PCs in this Labs test are happy to play that role.



How we test

Details of this month's benchmarks and tests

We focused on everyday speed with our benchmarks, starting off with the CPU. Here, we used Geekbench 6.4 and Cinebench 2024 to test both single-core and multicore performance.

PCMark 10 is a more rounded test, as it places demands on all the core components: CPU, GPU, RAM and SSD. Anything above 10,000 suggests that the system will feel fast in the chosen task, while results of 7,000 or more indicate that the PC will cope fine.

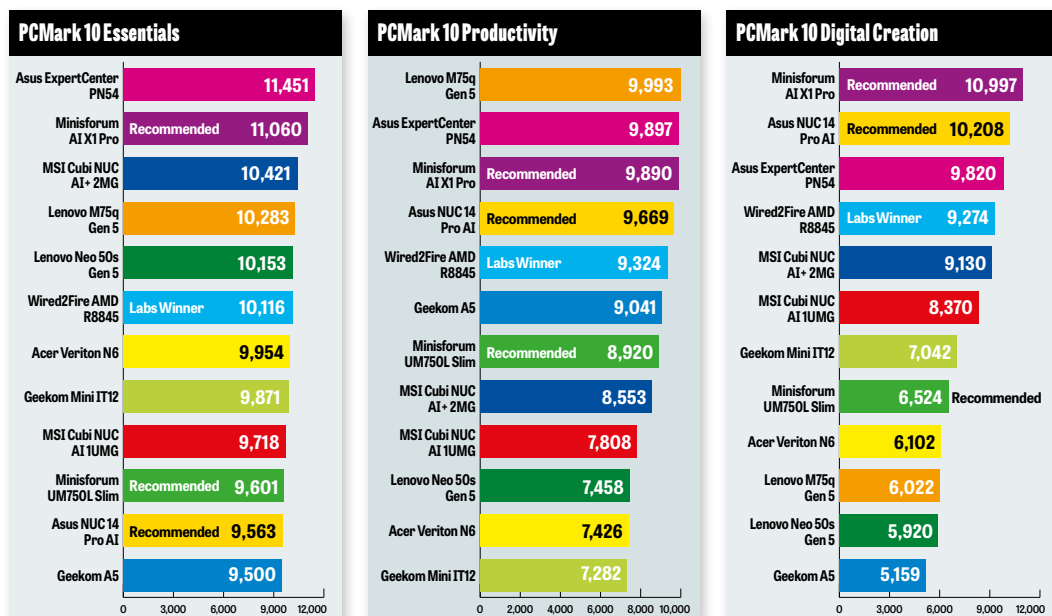
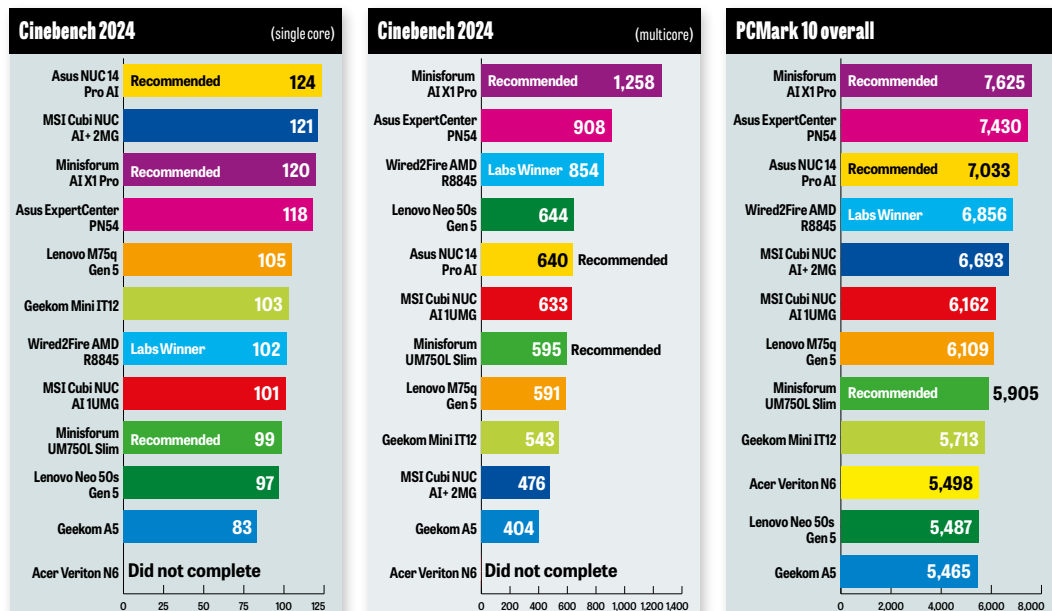
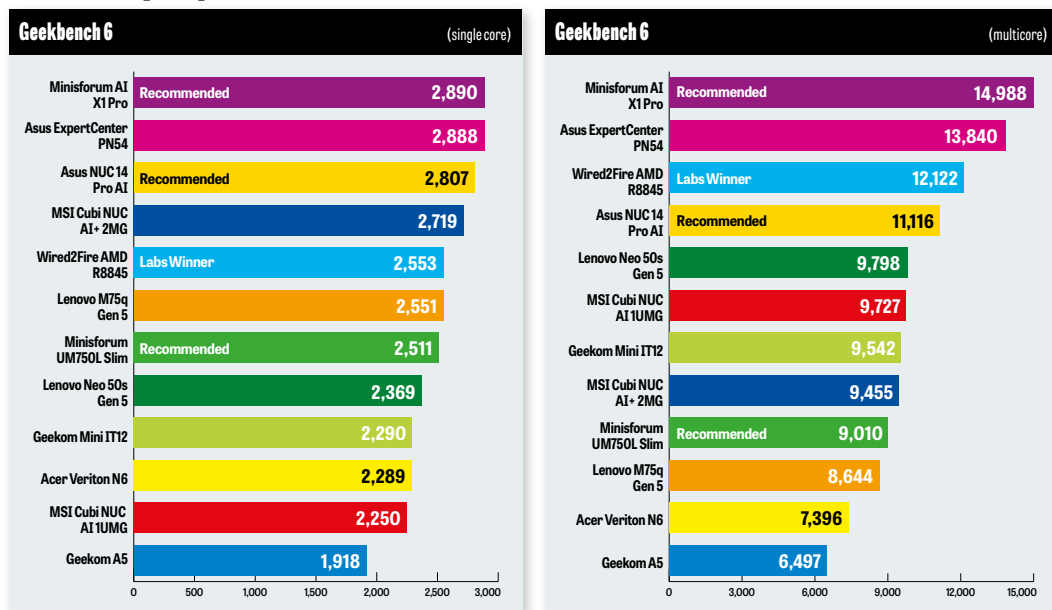
Next we turned our attention to the GPU. As our results show, mini PCs as a category aren't a natural choice for gamers, but that doesn't mean that they can't play games at all. All but two of the test systems produced playable frame rates in *Shadow of the Tomb Raider* at 1080p, even if we had to drop to its lowest graphics settings. We also print scores for 3DMark Time Spy, which is a synthetic benchmark but provides a great at-a-glance score so you can compare systems' theoretical 3D acceleration. Not just for games; for any software that takes advantage of the GPU.

The CrystalDiskMark scores show basic straight-line speeds for copying and writing data to disk.

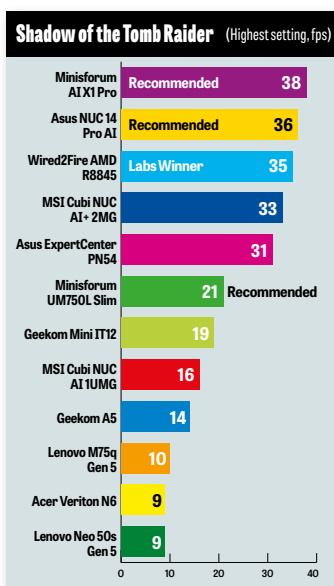
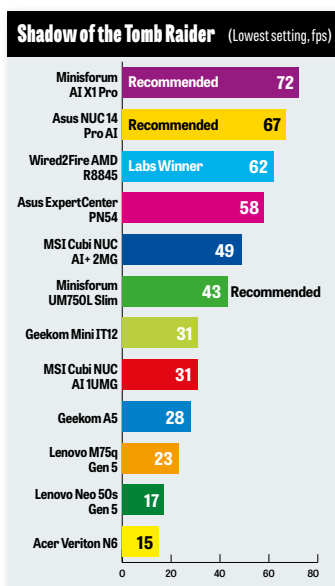
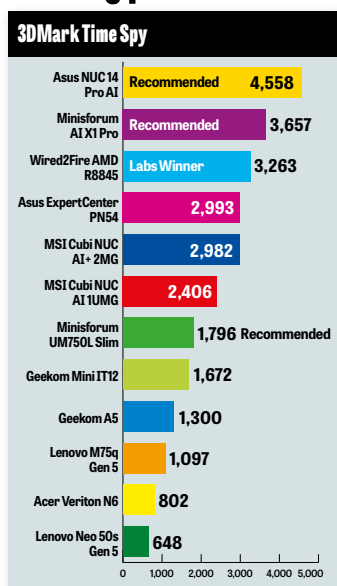
We print the comparative volume sizes (based on width by volume by depth, but ignoring the feet) to give you an instant idea of how these computers compare.

Finally, we come to power consumption and running costs. We measure draw at idle and at peak (pushing the CPU and the GPU to their maximum), then extrapolate running costs over five years based on an eight-hour working day and the current 24.5p per kWh price for electricity. The results are an estimate, for guidance only, but it's a handy way to show the long-term impact of a few watts here and there.

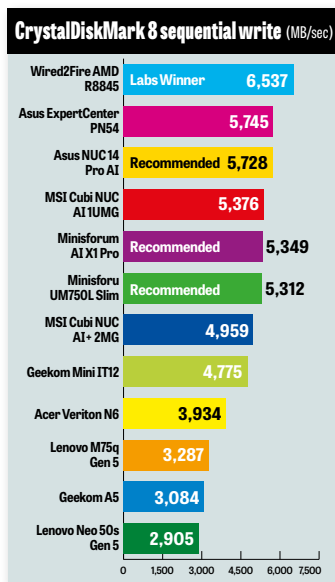
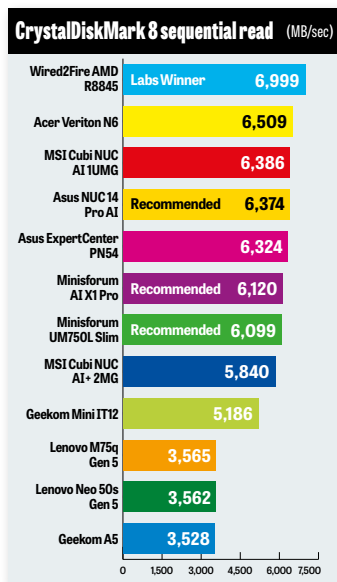
General-purpose tests



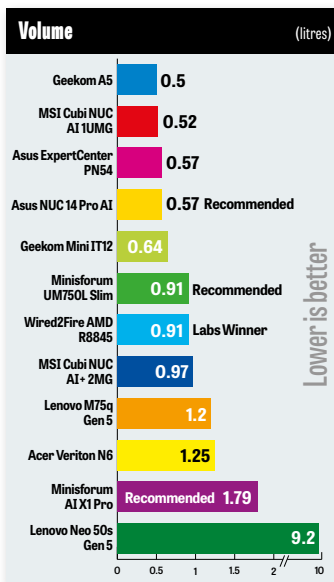
Gaming performance



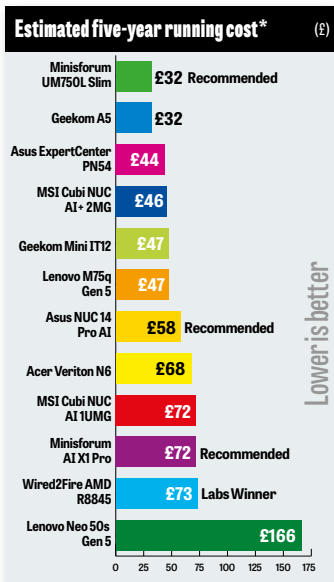
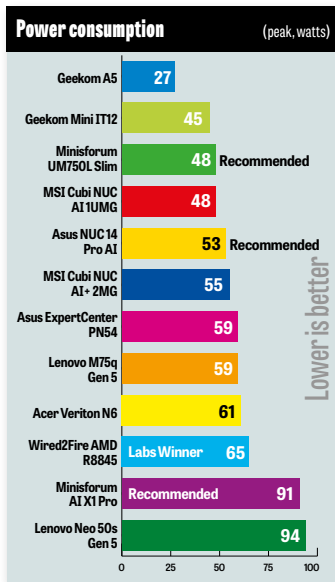
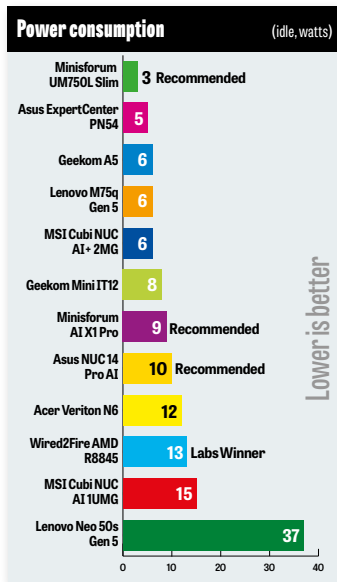
Disk performance



Relative size



Power testing results



View from the Labs

Windows could learn a lot about size and simplicity from mini PCs

I loved writing this Labs. Unpacking a dozen PCs, testing them, then tidying them away into a compact stack. I marvelled at their design, and in many cases finished up thoroughly satisfied by the value on offer. In fact, there was only one thing I didn't like.

Perhaps you've experienced returning from holiday to the realisation that your bathroom is too small, the heating isn't much cop and the view is pants.

That, but with Windows.

I haven't used Microsoft's OS much lately, spending most of my time in Google Docs on a Chromebook. As a writer with only the occasional need for proper software, working in a simple, browser-based interface is ideal. I get a responsive PC, quick and painless updates, and anything I particularly care about stays in the cloud.

So perhaps it's inevitable that Windows seems like far, far too much. It has to cater to every PC maker, every PC user, and Microsoft's interpretation of what we all want. Superficially it's slick and reassuring, but it's often incomprehensibly slow. You find yourself reading cycled platitudes like "Sit back and relax while the magic happens" while your new PC applies an hour's worth of updates.

How to fill the time? I found myself marvelling at Task Manager's process list. I like to sort them all by CPU time or memory. I think about the resources everything uses, and how it didn't used to be like that.

Perhaps that's just what progress feels like. Or perhaps it's the appeal of the mini PC. Most users probably don't care about ultimate performance, or minutiae such as clock speeds and RAM timings. Mini PCs simplify things; if only we could do the same with their operating system. ●



Simon has spent years hefting bulky PCs around for professional reasons.



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Business backup 2025

If you haven't put every necessary procedure in place to protect your data then you're playing with fire, says **Dave Mitchell**, who also reviews four services that can help



Companies that don't have a robust data backup and recovery strategy are playing with fire and recklessly putting their business and their employees' livelihoods at risk. The increasing frequency of sophisticated ransomware attacks are a clear and present danger, but businesses also need to protect themselves against a raft of other major incidents including data breaches, severe weather events, fire, floods and equipment theft.

Data protection doesn't need to be challenging, however: there are plenty of top-quality on-premises backup products on the market that are suitable for a wide range of IT environments and budgets. Along with all the tools needed to manage a complete strategy, they support all popular client platforms and applications, with the best products allowing you to create a hybrid data protection strategy that combines on-site and cloud destinations with essential support for immutable ransomware-proof backups.

This month, we look at backup products designed to be run on-premises and test software solutions from four established names –

Arcserve, Arctera, Hornetsecurity and Nakivo. They're all very affordable options for SMBs that all support immutable backups, and we've tested them in the lab to help you make the right buying decision.

Stand and deliver

Any business that thinks it's too small to be of interest to cybercriminals needs to look at the ransomware disaster that struck KNP Logistics Group. This 158-year-old UK company was sunk with the loss of 700 jobs because ultimately it didn't have a fully tested disaster recovery strategy in place.

True, the attack was initiated using an easily guessed account password, but this afforded the hackers full access to KNP's internal systems, allowing them to spread out laterally across the network and encrypt all data. One of their final acts before

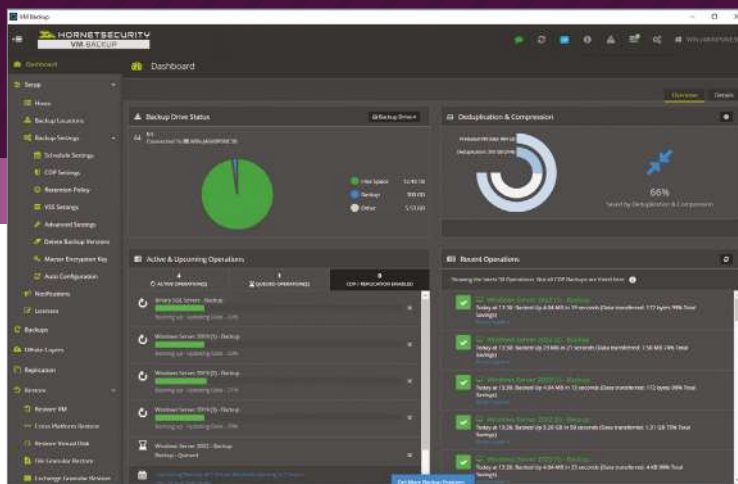
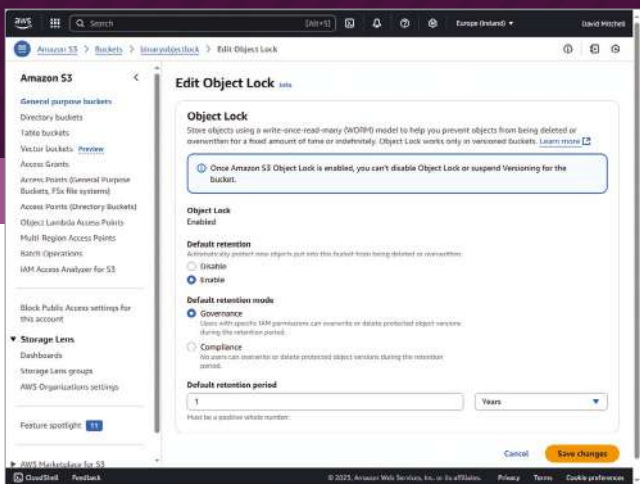
"A standard '3-2-1' hybrid data backup strategy is no longer enough. You should now consider adding another stage"

BELOW Arcserve's UDP software can be managed on-premises or in the cloud

issuing a reported £5 million ransom demand was to trash KNP's backup servers and delete all existing backups.

The moral of this sad story is that a standard "3-2-1" hybrid data backup strategy is no longer enough. This calls for three up-to-date copies of your data, backed up to two different types of storage media with one copy kept off-site, but you should now consider adding another stage.





Called “3-2-1-1”, the fourth stage requires data to be backed up to immutable storage. This is a great defence against ransomware attacks as once backup sets are written to WORM (write once, read many) storage, they cannot be changed, overwritten or deleted until the retention period you set has expired.

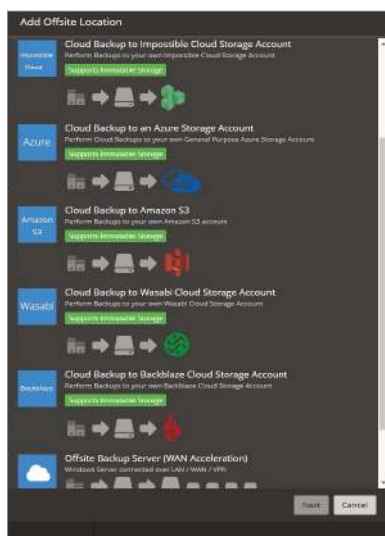
All four backup products in our guide support this, and if you choose one that can use cloud storage it's yours for the asking. Both Amazon and Microsoft offer immutable cloud storage with their respective S3 Object Lock buckets and Azure Blob Storage, but there are plenty of others, including Wasabi and Backblaze; check to see which ones your prospective software supports.

On-premises advantages

Hosting on-premises backup software offers a number of advantages over cloud-based solutions. You don't need an internet connection to access backup data for recovery purposes and, as it's stored at an in-house primary location, you have total control over access security.

And on the matter of access security, lock this down for your backup server to make access more difficult for ransomware attackers – if they can get into the server, they can delete its backups. Don't use simple passwords for the administrative account, isolate the server from the Active Directory domains of which your application servers are members and enforce multi-factor authentication (MFA) for all backup administrators and support staff.

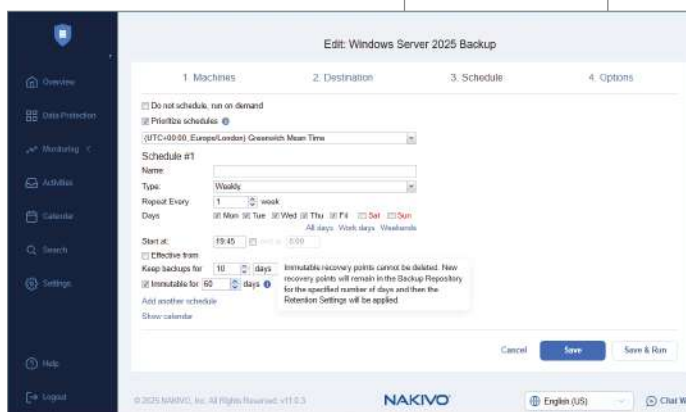
Naturally, up-front expenditure for the host system will be higher than a cloud backup service, but you'll only need to factor in maintenance costs and monthly or yearly subscription fees if you're using immutable cloud storage. Host hardware demands for backup software aren't excessive, and one of the main areas of focus



ABOVE LEFT Amazon's S3 Object Lock offers ransomware-resilient immutable cloud storage buckets

ABOVE RIGHT Hornetsecurity's VM Backup provides great protection for virtual environments

LEFT VM Backup supports five immutable cloud storage providers



should be storage capacity and upgrade potential.

As you add more sources for backup, it's surprising how quickly storage can get eaten up – especially if you're protecting virtual machines (VMs) – so it's important to get a clear idea of how much you need now and well into the future.

You'll also have a much wider choice for backup locations. All four products in this guide can use local and network shared storage, NAS appliances and IP SANs for primary backup storage. One of the products in this guide can even be hosted on a NAS appliance.

ABOVE Nakivo's software can create its own immutable recovery points

Automatic for the people

A complicated backup strategy that relies heavily on human intervention is guaranteed to fail. Backup needs to be fully automated, so only choose products that provide full scheduling features so you can run jobs regularly.

Two factors determine the frequency of backup jobs and the speed you need to restore data. Backup frequency is determined by the recovery point objective (RPO), which defines the amount of data loss your business can accept. If you can only tolerate losing data created over the past few hours then you'll need to schedule backup jobs to run more than once a day.

A recovery time objective (RTO) defines the length of time your business can survive without access

to its systems. You may need more than one RTO as a host managing business-critical applications will have a much shorter RTO than one providing basic file-sharing services.

Disaster blaster

Implementing a data backup strategy is the first step towards business continuity, but don't relax yet as you must test every restore service to ensure all unforeseen problems are ironed out. With the

ever-present threat of ransomware, it's worth cultivating a cybersecurity mindset that assumes you'll be attacked and how you will mitigate it.

It's easy to slip into a false sense of security once backups are happily chugging away to your schedule, so you should implement regular contingency planning. Otherwise known as a “3-2-1-1-0” strategy, this confirms that all copies of data are correctly maintained in all backup locations, including immutable storage, that RTOs and RPOs can be met and all recovery processes have zero errors, so you can be confident it will work when a real disaster strikes.



Arcserve UDP 10.2

Powerful data protection for physical and virtual environments with top recovery features

SCORE ★★★★★

PRICE 1TB front-end licence, £649 exc VAT per year from arcserve.com

UDP (unified data protection) has a deployment option for every occasion as along with Arcserve's 10000-series turnkey appliances, you can install the backup software on your own on-site hardware and choose between local and cloud management. On review is UDP 10.2, which has a sharp focus on ransomware protection as it supports Arcserve's new cloud-hosted Cyber Resilient Storage.

This teams up immutable WORM (write once, read many) storage with advanced encryption to stop ransomware attacks from changing, encrypting or deleting your backup sets. The Cyber Resilient Storage feature provides even more protection by sending immutable snapshots of backup data stores to other on-premises storage.

Central to UDP is recovery point servers (RPS), which define backup locations, support any storage on the UDP host as well as other networked Windows Server systems, enforce AES-256 encryption and apply deduplication and compression. Multiple RPS servers are supported, with each performing global deduplication,

and they can be replicated to the cloud for extra protection.

UDP offers two licence plans, with socket licences applied to the systems being protected, supporting unlimited VMs and having no restrictions on RPS storage capacity. Front-end TB (FETB) licences are based on the amount of RPS storage used before deduplication and compression are applied and support unlimited backup sources.

Prior to deploying UDP, you should decide whether you want on-premises or cloud management. A migration wizard helps with switching from on-premises to cloud and installing the gateway component on a separate Windows host, but there's no easy return path as the local console is disabled.

We already have a cloud-managed instance of UDP 10 running in the lab, which we upgraded to 10.2. The cloud console also gets a refresh with an extra option in the Protect menu for adding Cyber Resilient Storage.

Backup sources are added to UDP from the portal's Protect tab and physical systems will have an agent automatically pushed to them. To declare our Hyper-V and VMware

ABOVE RPS storage usage can be closely monitored and recovery jobs started from the portal

"The Cyber Resilient Storage feature provides protection by sending immutable snapshots of backup data stores to other on-premises storage"

BELOW The UDP cloud portal provides easy management access to all backup features

virtual machines (VMs) for agentless backup, we imported our hypervisors and selected the VMs to be protected.

Protection plans are very versatile as these contain selected nodes and VMs, an RPS, the desired number of recovery points and a schedule that can be run as often as every 15 minutes. UDP doesn't provide MS365 protection, with Arcserve offering a separate SaaS solution for this.

Extra stages can be added to plans and include an assured security scan that checks for malware and assured recovery, which creates a temporary VM on a virtualisation host, confirms it works and

then deletes it. Stages can be added to replicate data to the Cyber Resilient Storage and use the virtual standby feature which creates a VM backup, uses a heartbeat service to monitor the primary node and brings the standby VM online if it fails to respond.

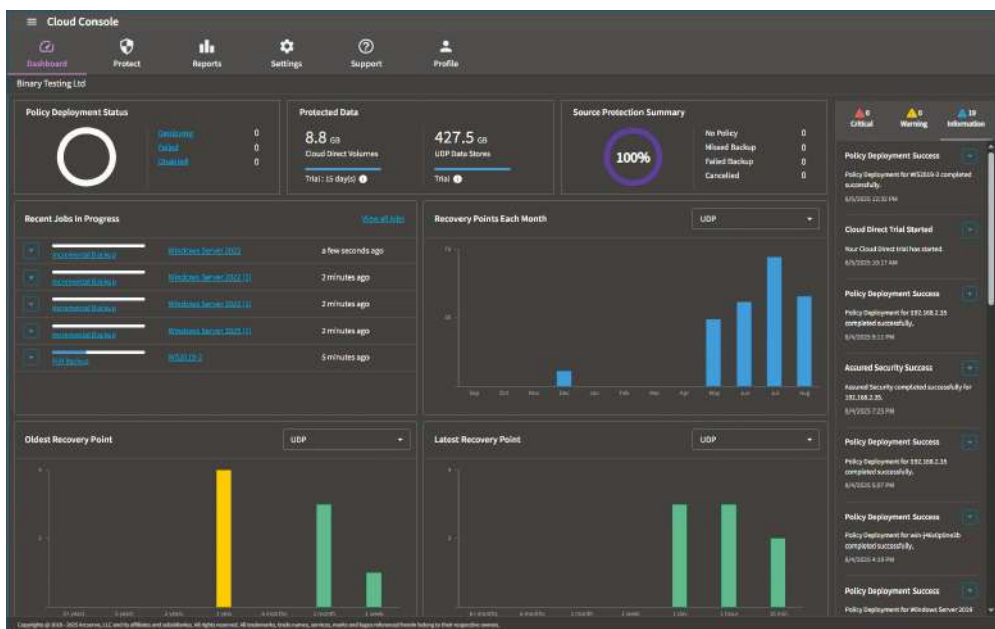
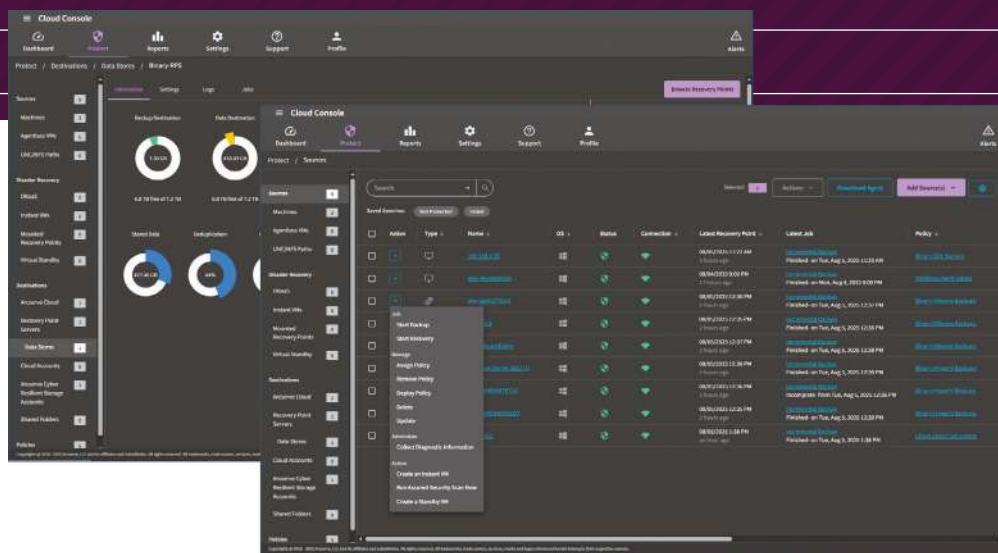
The cloud console also provides access to Arcserve's Cloud Direct – a separate service that doesn't require any on-premises hardware. Lightweight agents are downloaded from the console, deployed to sources and use protection plans that back them up directly to cloud storage.

UDP offers a wealth of recovery services. Files and folders can be restored directly from the cloud portal and you can recover a VM, a virtual drive or an entire volume. For our SQL Server host, we could browse its databases and swiftly restore them back to the host.

Arcserve's UDP 10.2 is a versatile backup and recovery solution designed to protect physical and virtualised environments. Available with a choice of affordable licence plans, it provides top-notch disaster recovery features, can be locally or cloud-managed, and Arcserve's Cyber Resilient Storage adds valuable ransomware protection.

REQUIREMENTS

Backup host: Windows Server 2012 upwards





Arctera Backup Exec 25

A classy data protection solution with plenty of ransomware protection features at a decent price

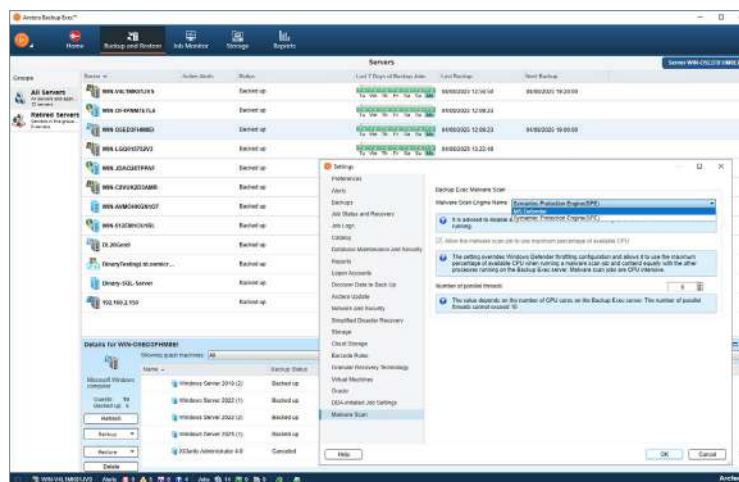
SCORE ★★★★★

PRICE Simple Core Pack, 5 instances, £612 exc VAT per year from [senetic.co.uk](https://www.senetic.co.uk)

Backup Exec (BE) has always been one of our top choices for on-premises data backup and recovery, and after Cohesity's acquisition of Veritas at the start of 2025 it begins a new phase in its life as Arctera's flagship product. Arctera immediately assigned it a dedicated software development team, and we're already seeing the fruits of its labour as Backup Exec 25 (BE25) delivers plenty of new features.

Along with full support for Windows Server 2025, it enhances Microsoft 365 (MS365) protection with options to restore Exchange items to a PST file and secure Teams private channels. There's a new role for restore administrators, and the integral malware detection service now supports the Symantec Protection Engine (SPE).

Arctera cuts through any licensing confusion as its Simple Core Pack subscription service now offers instance metering or capacity metering options, with both enabling all BE25 features. The former will appeal to smaller businesses as it's based on compute instances, which can be a physical system, a virtual



machine or ten MS365 users, with the base price including an extra bonus instance for ten MS365 users.

Deployment is a breeze. We loaded BE25 on an HPE ProLiant server running Windows Server 2022 in 20 minutes. Its widget-based console dashboard is very informative, and another new feature is that BE25 automatically creates a self-protect backup job for the media server.

Protecting physical servers requires an agent to be deployed to each one from the console, and for our Hyper-V systems we pushed the agent to the hypervisor hosts for agentless VM backups. It's even easier to protect VMware VMs: we declared our vCenter hosts to BE25 simply by providing their IP addresses and credentials.

Arctera has perfected MS365 protection; adding our tenant only required us to use the link and unique device code generated by BE25. MS365 backup jobs require a deduplicating store, which we created on the media server, but

ABOVE BE25 can run malware scans using Windows Defender or the Symantec Protection Engine

add multiple stages if required and set schedules. For VM backups, you have a forever incremental strategy that automatically starts with one full backup followed by partial backups. Multi-stream backups within a VM are supported, and it can secure virtual disks in parallel.

BE25 is absolutely brimming with ransomware protection. Along with malware detection it can encrypt

"SMBs seeking an affordable data protection solution for physical and virtual environments will love Arctera's Backup Exec 25"

backup sets, and its anomaly detection service comes into play after 30 backups have run. This compares criteria such as backup image sizes, item counts, job times and

the amount of transferred data and posts alerts in the console.

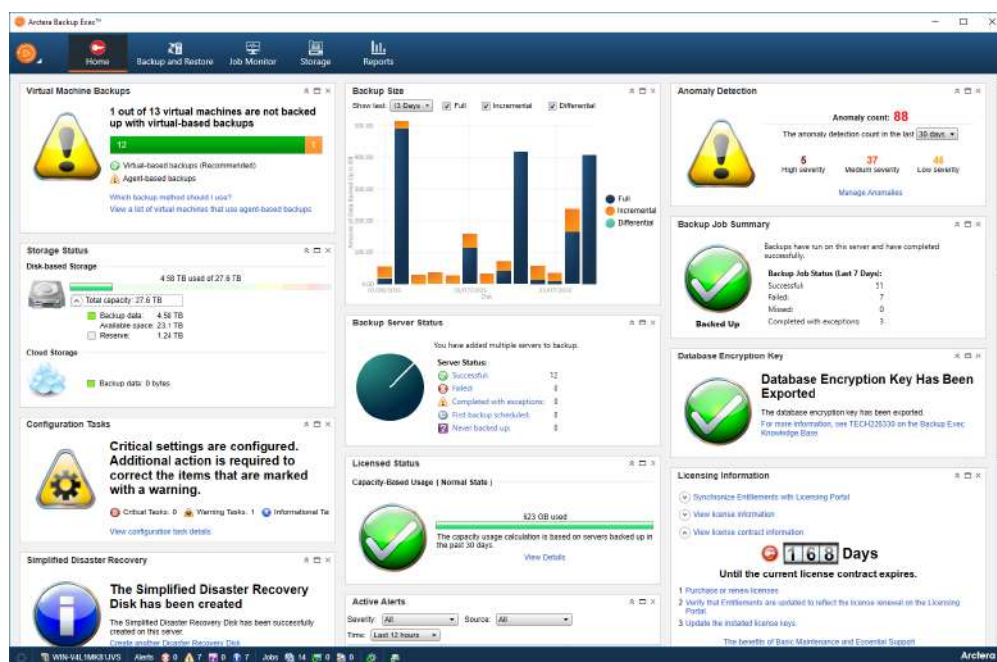
Malware scans can be made part of a restore job or run manually on selected backup sets using Windows Defender or SPE. Use Windows Defender with caution as its CPU demands on the BE25 host are high, although you can modify the job to use fewer parallel threads.

Restore features are outstanding: you select a source, pick a recovery point, browse its files, folders or volumes and decide where to send items. BE25's Granular Recovery Technology restores items such as SQL databases, and you can recover individual Hyper-V and VMware virtual disks, use Instant VM Recovery to create a new VM from an existing backup and create a simplified recovery disk for bare metal recovery.

SMBs seeking an affordable data protection solution for physical and virtual environments will love Arctera's Backup Exec 25. The licence plans are easy to manage, it offers essential ransomware protection, and this latest version introduces plenty of new features.

REQUIREMENTS

Backup host: Windows Server 2012 onwards





Hornetsecurity VM Backup 9.13

Drag and drop takes the very affordable VM Backup to the top of our list for protecting virtualised environments

SCORE ★★★★★

PRICE Unlimited Plus, Perpetual, £445 exc VAT per host from [hornetsecurity.com](https://www.hornetsecurity.com)

Businesses seeking a dedicated backup solution for protecting virtualised environments will find Hornetsecurity's VM Backup has lots of appeal. Along with support for VMware, Hyper-V and the increasingly popular Proxmox, its smart management console and drag-and-drop operations make it very easy to create VM protection strategies.

It's good value as pricing is based only on the number of hosts and not sockets or CPUs. The free version protects two VMs, while a Standard perpetual licence costs £289 per host and supports up to five VMs for each.

Any number of VMs can be secured with the Unlimited version (£354), but Unlimited Plus offers the best ransomware protection as it can use immutable cloud storage from Microsoft Azure Blob, Amazon S3, Backblaze B2 and Wasabi with the latest version adding support for Impossible Cloud Storage. This version is also available as a monthly subscription of £5 per backed up VM.

Hornetsecurity claims a 15-minute deployment, which we found quite

achievable: it took five minutes to load the software on a Windows Server 2022 host, after which we followed a wizard to create a local backup repository, declare our hypervisors, choose VMs and schedule our first backup. VM Backup pushed an agent to our Hyper-V hosts, but we only had to provide vCenter IP addresses and admin credentials for VMware.

You then simply drag and drop VMs onto the chosen backup repository icons and do the same for schedules. Custom schedules can be created and set to run backups at regular intervals, and include secondary and tertiary backups to different offsite storage locations with optional encryption.

Primary backup locations include local and external storage, iSCSI targets and network shares. For offsite backup, you can declare standard or immutable cloud storage, physical devices and network shares. We had no problems adding a Synology NAS share and an Amazon S3 bucket with Object Lock enabled.

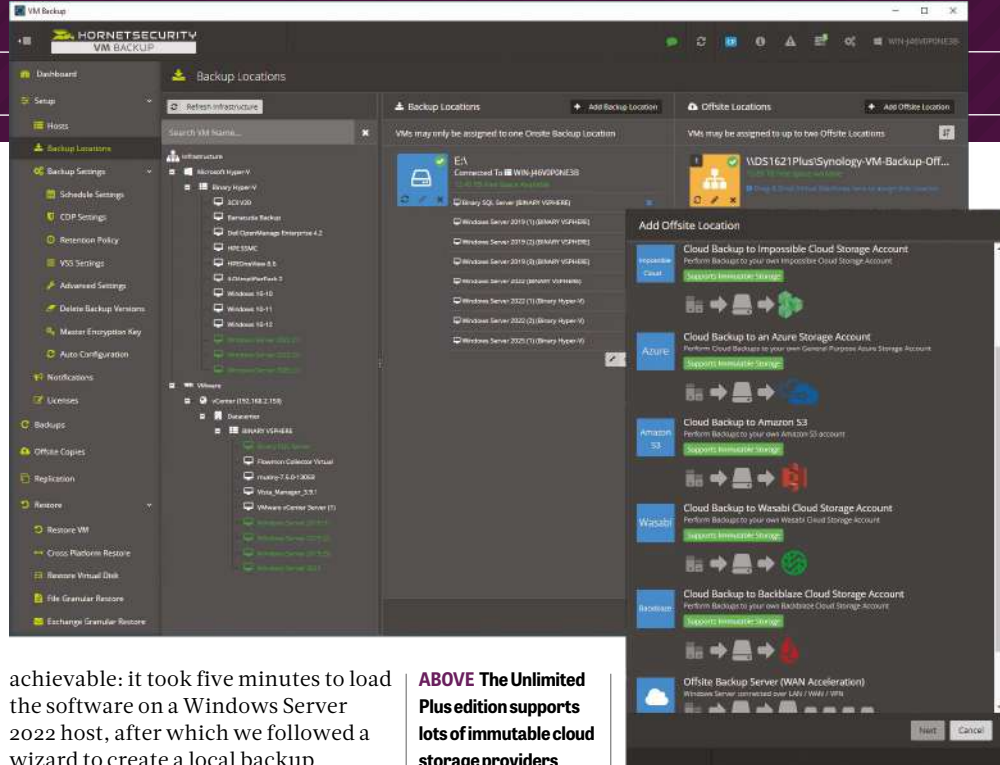
Another option for offsite backups is to use Hornetsecurity's free Offsite

ABOVE The Unlimited Plus edition supports lots of immutable cloud storage providers



"Its smart management console and drag-and-drop operations make it very easy to create VM protection strategies"

BELOW Drag-and-drop operations make it easy to create VM protection strategies



Backup app on a remote Windows Server host. This enables automatic replication of locally backed up VMware and Hyper-V VMs and offers instant boot services for fast recovery.

The CDP feature provides higher levels of protection, with options to run backups as often as every from minutes. From the VSS settings page you can also enable application-

consistent backups for hosted apps such as SQL Server.

A set of default data retention policies are provided, and you can create custom ones for on- and off-site backup locations. Choose how many versions you want to keep, decide whether older ones are deleted or archived, and just drop VMs onto them to apply the policy.

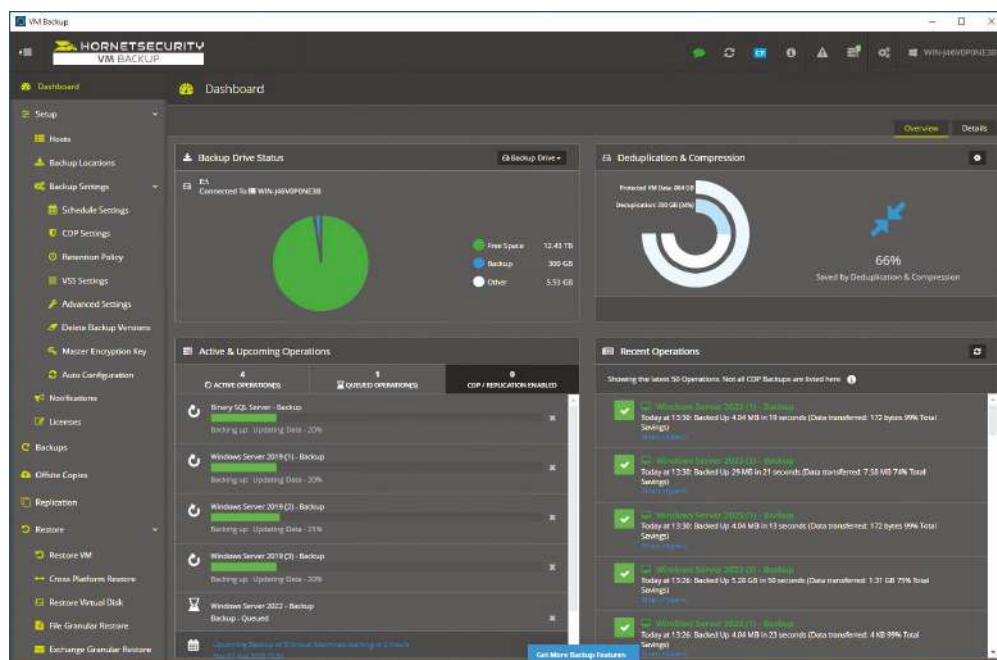
All editions include the Sandbox & Verification feature, which confirms the integrity of all backups. Along with verifying data stored in backups, it runs a background job that clones a VM back to the original host and confirms it runs correctly.

Recovery features are just as easy to use. A wizard helps choose a VM, restore its virtual hard disk, clone it or boot it straight from a backup to its original host or to another one. VM Backup's GRT services allowed us to restore files and folders from selected VMs, along with our SQL Server database files.

The affordable VM Backup makes protecting Hyper-V, VMware and Proxmox virtualised environments a breeze. Simple drag-and-drop operations make it remarkably easy to use, it offers plenty of data protection features, and extensive support for immutable cloud storage provides essential ransomware protection.

REQUIREMENTS

Backup host: Windows Server 2012 upwards



Nakivo Backup & Replication 11

Perfect for SMBs seeking the best host platform support, great data protection features and good value

SCORE ★★★★★

PRICE Enterprise, 5 servers, perpetual, £937 exc VAT from nakivo.com

Many on-premises business backup solutions require a dedicated Windows Server host, but Nakivo Backup & Replication (NBR) is far more versatile as it supports a huge range of host platforms. You can run it on Windows, Linux, VMware or Nutanix and host it in the cloud on AWS EC2, while smaller businesses can cut costs by using a NAS appliance, with Nakivo supporting all the key players including Synology, Qnap and FreeNAS.

Rasperry Pi hosts are no longer supported, but the latest NBR 11 introduces a wealth of new features including agentless backup and recovery for the popular Proxmox Virtual Environment. It now provides cloud-to-cloud backup for Microsoft 365 (MS365) plus real-time replication of VMware virtual machines, and introduces source-side encryption so backup data is secured before it leaves protected systems.

Nakivo is commendably transparent about pricing and provides a handy calculator on its web site for perpetual licences or per-workload subscriptions. We've shown the price for an Enterprise five-server perpetual licence with a two-year 24/7 support contract. MS365 licences are subscription only, with a one-year licence for 25 users costing a very reasonable £240.

For testing, we installed NBR on a Synology DS1621+ NAS appliance and were pleased to see the latest version certified and available in the DSM Package Center app. Another bonus is that it automatically loads a free 15-day trial with unlimited support for all features.

NBR comprises three service components: a Director for browser-based management, Transporters to handle backup, replication and recovery operations, and Repositories for storing backups. We created a 16TB primary repository on our NAS but you can also use local or network shares as well as standard and immutable cloud storage from Amazon EC2 and S3, Microsoft Azure Blob, Wasabi, Backblaze B2 and other S3-compatible providers.

Sources are declared to the NBR inventory, and our physical Windows Server 2025 systems and Hyper-V hosts had the Transporter service pushed to them. NBR uses agentless backup for VMware so we only had to provide our vCenter IP address and admin credentials and all its VMs were made available for selection.

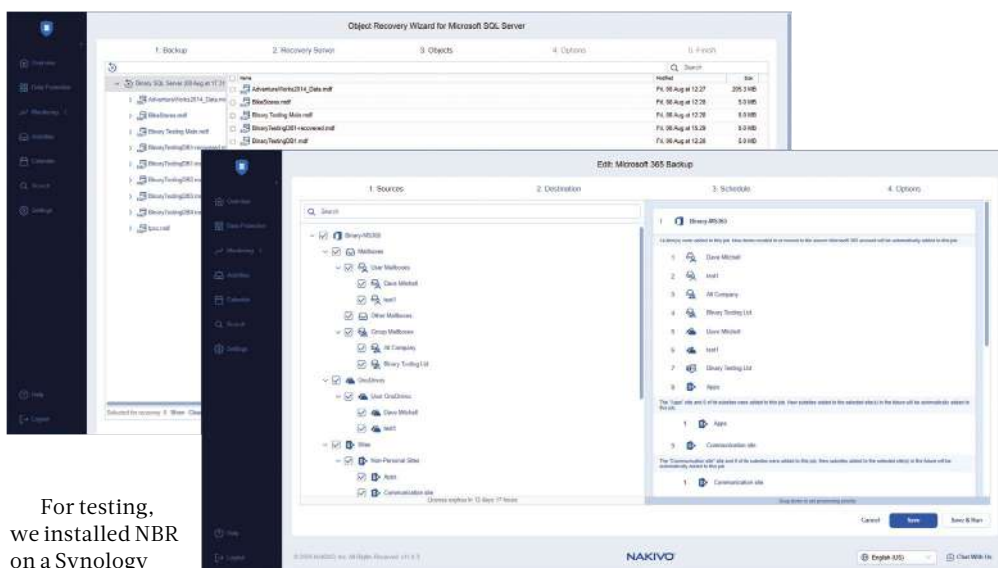
NBR also created a self-protect job and, for extra security, it should use a dedicated repository and have password protection and encryption

ABOVE Nakivo offers good recovery features and MS365 backup facilities



"Nakivo Backup & Replication 11 is the most versatile on-premises backup solution as it supports more host platforms than anyone else"

BELOW NBR presents an informative web console for setup and management



applied. In the event of a host failure or ransomware attack, you can use these backups to restore the configuration to a new host.

Nakivo puts a high priority on ransomware protection. You can enable encryption on backup jobs and immutability for a set number of days. NBR can also use a separate server hosting Microsoft Windows Defender, ESET, Sophos Intercept X or Clam AV to scan backups for malware prior to recovery.

MS365 protection is easy using a simple three-step authentication process, and we created a backup job

to secure our accounts to an Amazon S3 immutable bucket with Object Lock enabled. NBR's granular recovery allowed us to select any component,

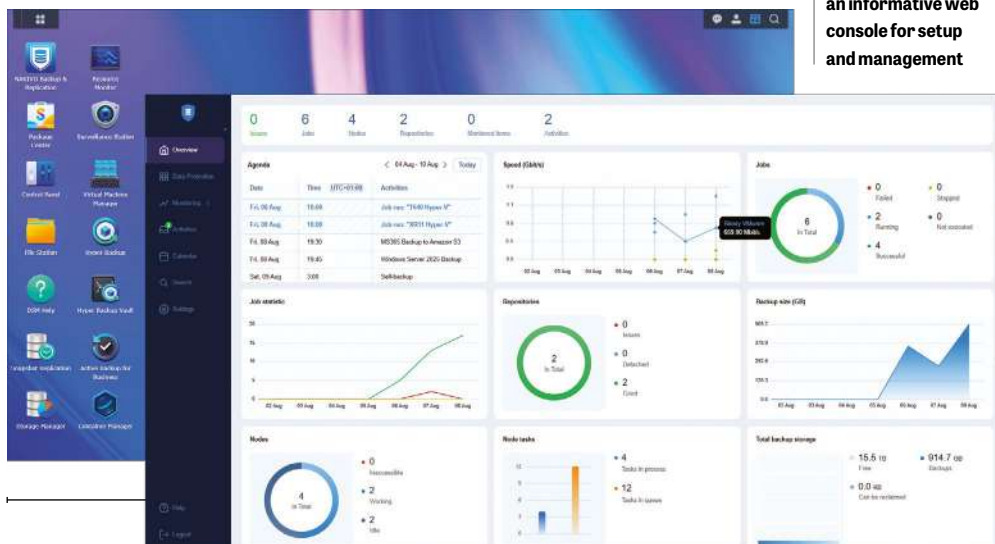
choose items and restore them to their original location or to another user.

General restore services are excellent. We used the granular recovery to restore files, folders and SQL Server databases back to physical systems and VMs. For disaster recovery we could run full VMware and Hyper-V host recoveries, replicate VMs as clones and use Flash VM Boot jobs to create new VMs from the backup repository without restoring them first.

Nakivo Backup & Replication 11 is the most versatile on-premises backup solution as it supports more host platforms than anyone else. Available in a range of affordable licence plans, it's easy to manage, delivers solid data protection services and includes extensive ransomware protection measures.

REQUIREMENTS

Backup host: Windows 10/Server 2012 upwards, Linux, VMware, Nutanix, AWS EC2, supported NAS appliance





D-Link DBR-700

WAN redundancy, wireless network management and plenty of 2.5GbE ports at a good price

SCORE ★★★★★

PRICE £232 exc VAT
from lambda-tek.com

D-Link's DBR routers target small businesses with up to 100 users that want a simple security appliance with VPN routing, WAN redundancy and wireless access point (AP) management. The range comprises two models, with the DBR-600-P and DBR-700 both delivering 2.5GbE multi-gigabit ports across the board.

There are distinct differences between them. The DBR-600-P has nine copper 2.5GbE ports, provides 802.3at PoE+ services and its USB port supports a 4G/5G modem. The DBR-700 we reviewed doesn't have the USB port or PoE services but its ninth port is the 2.5GbE SFP fibre variety, which supports longer connection distances.

The DBR-700 has good WAN redundancy features; the last copper port is a dedicated WAN interface, while the SFP port and the eighth copper port can serve LAN or WAN duties. Team either of them up with the dedicated port and you can choose from dual-WAN load-balanced or failover modes.

The router's SPI firewall claims a decent raw throughput of 2Gbits/sec,

while other security measures include an intrusion prevention service, DDoS detection, user authentication and web filtering. Wireless management is currently limited to D-Link's DBR-X3000-AP Wi-Fi 6 model, but it can handle up to 15 of them.

Deployment is simple if you follow the web console's quick-start wizard, which requires the default admin password to be changed. The console provides easy access to all features and presents a dashboard map showing WAN and appliance status, along with connected clients and managed APs.

When we connected a DBR-X3000-AP, the router automatically identified it and added an icon in its status display. Individual APs can be manually configured by clicking on their icon, while for multiple APs you can use the console's AP management page, create multiple SSID profiles and apply them to selected devices.

Within profiles, you can use the Smart Connect option to present one SSID for both 2.4GHz and 5GHz radios or enable them separately, apply security up to WPA3, set L2 isolation and assign a quality of service (QoS) profile. One custom captive portal can also be presented on a guest VLAN with either local or Radius authentication.

The AP's gigabit port means you won't see the extra performance

ABOVE The DBR-700 includes a 2.5GbE SFP fibre port among its selection of connectors

"At only £232, the DBR-700 is good value as it delivers a full house of 2.5GbE ports teamed up with solid WAN redundancy features"

benefits of its 160MHz channels.

Microsoft's NTtftp utility recorded maximum close-range upstream and downstream speeds of 113MB/sec between a Wi-Fi 7 equipped Window 11 desktop and a server on the 2.5GbE LAN, while real-world tests using large file copies averaged 88MB/sec.

The SPI firewall is enabled with one click, along with a stealth mode to stop the router responding to WAN port scans and an anti-spoofing check. You can add custom firewall policies with rules and filters but the web filter is very basic as it only

applies manually created website keyword checks.

To create a dual WAN link you need two active connections and, if you set them both as always on, the router load-balances traffic. For failover mode, you set this for the second WAN port and choose ICMP or DNS queries for two internet target hosts and set a timeout period.

Both modes worked fine, with the console's device dashboard showing traffic being distributed evenly across both WAN interfaces when load-balancing was active. In failover mode, we disconnected the primary WAN link while running a continuous Ping to an internet address, which timed out for eight seconds while the router swapped over to the backup link.

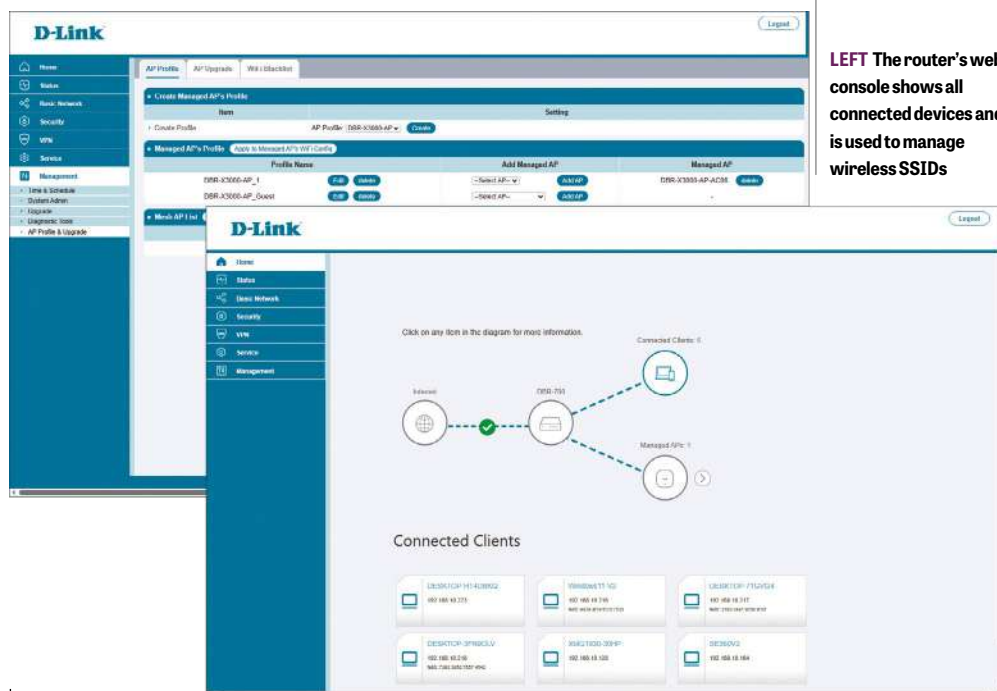
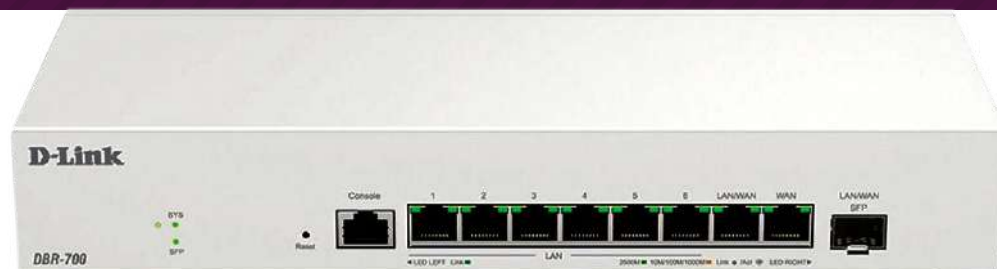
With the primary link restored, the router automatically returned it back to active duty. Plenty of log and alert options are provided: you can send them to a Syslog server, an email server or the router's internal storage.

At only £232, D-Link's DBR-700 is good value as it delivers a full house of 2.5GbE ports teamed up with solid WAN redundancy features. Unlike TP-Link's cheaper gigabit-equipped DR3650v it can't be cloud managed, but it will appeal to small businesses that need a low-cost security appliance with centralised wireless network management. **DAVE MITCHELL**

SPECIFICATIONS

Desktop chassis • 9 x 2.5GbE (WAN, WAN/LAN, 6 x LAN, SFP LAN/WAN) • RJ45 console port • external PSU • 280 x 120 x 45mm (WDH) • web browser management • limited lifetime warranty.

Options: DBR-X3000-AP, £76 exc VAT



LEFT The router's web console shows all connected devices and is used to manage wireless SSIDs

Synology DiskStation DS1825+

This smart desktop NAS offers a high capacity, good 10GbE performance and top data protection features

SCORE ★★★★★

PRICE Diskless, £858 exc VAT from [ballicom.co.uk](https://www.ballicom.co.uk)

Synology's eight-bay desktop NAS appliances have always been a popular choice for SMBs as they offer an impressive storage capacity in a desk-friendly format teamed up with plenty of features. It's been a long wait but after four years, the dependable DS1821+ has finally been replaced by the DS1825+.

Alas, there are no changes in the processor department as the DS1825+ sports the same quad-core 2.2GHz AMD Ryzen V1500B as its predecessor, along with all of Synology's other 2025 Plus desktop models. Standard memory is doubled with a single 8GB stick of ECC DDR4 upgradable to 32GB, with the two SO-DIMM slots located behind a small panel in the base.

The USB-A 3.2 Gen 1 port count drops from four to three but networking sees improvements as instead of four gigabit ports, the DS1825+ is endowed with a pair of faster 2.5GbE multi-gigabit ports. The two eSATA expansion ports in the DS1821+ are replaced with dedicated USB-C ports for connecting up to two DX525 5-bay expansion units.

Two NVMe SSD slots are found in the side panel behind the first drive



4.1Gbits/sec, while backing up a 22.4GB folder containing 10,500 small files averaged 2.4Gbits/sec. IP SAN performance is equally good, with a 500GB iSCSI target

bay and can be used as a performance-enhancing cache or a standard high-speed storage pool. As a Plus model, the appliance comes under Synology's new drive enforcement policy so you can only use its own-brand HDDs and SSDs; fit anything else and it won't allow them to be used.

The DS1825+ also keeps the PCIe Gen3 expansion slot, but Synology's compatibility list is restricted to its own 10GbE and 25GbE expansion cards. We fitted a Synology dual-port 10GBase-T card, which was accepted without any problems.

For testing, we installed four 4TB Synology

HAT3300-4T HDDs, left the browser's quick-start routine to load the DSM 7.2 software and used the

Storage Manager app to create an 11TB RAID5 array.

One advantage of using Synology drives is that Storage Manager automatically checks and updates them with the latest firmware.

With the same CPU, the DS1825+ delivered very similar 10GbE speeds to the DS1821+, with a NAS share mapped to a Dell PowerEdge Windows Server 2022 host returning Iometer sequential reads and writes of 9.3Gbits/sec and 8.7Gbits/sec. Real-world test results were good, too, with large file copies between the appliance and server delivering read and write speeds of 4.9Gbits/sec and

ABOVE This eight-bay desktop NAS is good value for SMBs



LEFT The appliance comes with two 2.5GbE multi-gig ports

mapped to the server over 10GbE delivering sequential read and write rates of 9.2Gbits/sec and 8.9Gbits/sec. A dual 10GbE MPIO link saw read speeds ramp up to 18.5Gbits/sec, but write rates only increased to 9.2Gbits/sec. A cache can significantly improve random write operations, with a mirrored pair of 800GB Synology SNV3400 NVMe SSDs delivering respective throughput and IOPS boosts of 575% and 990% for the iSCSI MPIO target.

Synology's DSM 7.2 software offers a superb range of data management services and business apps along with peerless ransomware protection. It can apply full volume encryption while the WriteOnce feature enforces WORM (write once, read many) on selected NAS folders on Btrfs volumes, with the Compliance policy stopping storage pools, volumes and shared folders from being deleted by anyone – including administrators.

Backup services are equally good, and we love the three free Active Backup suite apps.

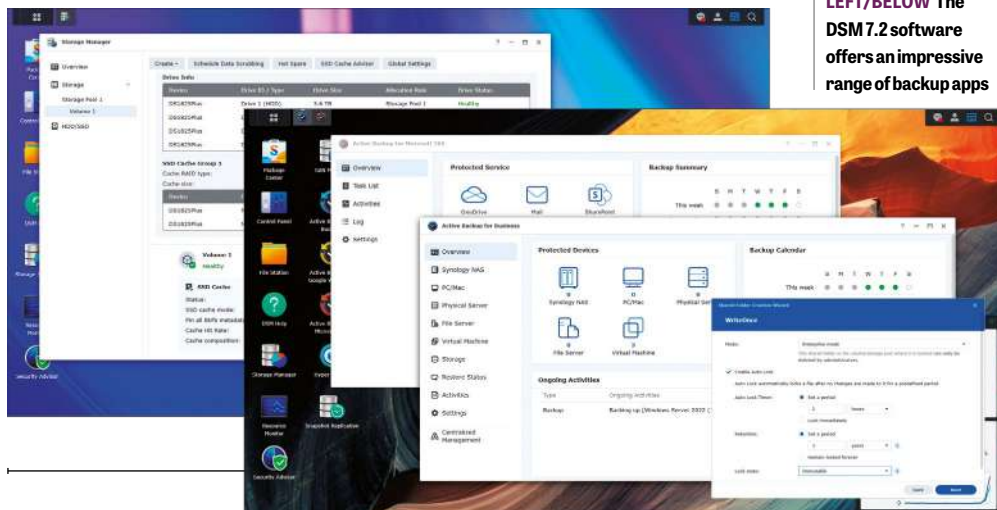
These can secure Google Workspace and Microsoft 365 accounts, with the Active Backup for Business app protecting servers, workstations and remote Synology

appliances as well as VMware and Hyper-V virtualised environments.

With the same CPU in residence the DS1825+ doesn't offer existing DS1821+ users a worthwhile upgrade path, but it will appeal mightily to SMBs seeking a NAS appliance with a high storage capacity and good performance at an affordable price. Synology's DSM 7.2 adds to its appeal as it delivers a wealth of business-class features, including great backup apps and essential ransomware protection. **DAVE MITCHELL**

"Synology's DSM 7.2 adds to its appeal as it delivers a wealth of business-class features, including essential ransomware protection"

LEFT/BELOW The DSM 7.2 software offers an impressive range of backup apps



SPECIFICATIONS

Desktop chassis • quad-core 2.2GHz AMD Ryzen V1500B processor • 8GB DDR4 ECC RAM (max 32GB) • 8 x LFF/SFF hot-swap SATA drive bays • 2 x M.2 2280 NVMe SSD slots • 2 x 2.5GbE • 3 x USB-A 3.2 Gen 1 • 2 x USB-C expansion ports for DX525 • 250W internal PSU • web browser management • 343 x 243 x 166mm (WDH) • 3yr hardware warranty



Performance monitoring

Get the best from your systems

If your servers are grinding to a halt, performance monitoring can reveal the cause. **Steve Cassidy** looks at the different approaches

You could say that *PC Pro* is all about performance monitoring. Every month, we put the latest hardware and software to the test, and award prizes and recommendations for the best devices. But in business, performance monitoring is less about choosing hardware, and more about understanding what your existing systems are doing.

While the idea may sound simple, it's a subject with a lot of intricacy and specificity to it. For example, our famous *PC Pro* benchmarks produce a single standardised measurement of things such as CPU speed, memory bandwidth and so on. That's anathema to business-grade performance monitoring, which is all about watching over a long period, observing how and when performance ebbs and flows, and trying to figure out why. You could think of benchmarks as a collection of snapshots, and performance monitoring as the complete motion picture.

Done properly, performance monitoring can be a very worthwhile pursuit. It can expose pinch-points or overload conditions in your systems, and addressing these can give you a big overall productivity boost. It can alert you to unexplained activity, which could be indicative of a bug in your setup or an ongoing below-the-radar security breach. And it can reveal when a particular resource is being underutilised, giving you an opportunity to consolidate your servers or scale back your cloud estate.

At the same time, performance monitoring isn't necessarily something

you can deploy quickly and easily, and the information you generate may not point to any obvious

conclusions. If you're considering introducing performance monitoring into your business, you should start by considering how you plan to do it, what information you hope to obtain, and what you can realistically expect to do with that data.

Inside or out?

There are two basic approaches to performance monitoring. One is to have it built into your software; while doing its primary job, your line-of-business app can be logging its own statistics in a form that's ready to be picked up by an orchestration package or analysis toolbox.

The other approach is to monitor externally, via specialist platforms with sparky names such as Datadog and Dynatrace. These deploy data collection agents to your servers, workstations and cloud resources to

watch over network traffic, memory consumption, CPU load and other measurements, and present reports and alerts in a natty integrated dashboard.

Each approach has its pros and cons. Native statistics can alert you to very specific performance metrics that aren't externally visible – for example, you can see exactly which bit of your e-commerce pipeline is gobbling up disk space. The downside is that reports don't directly connect to whatever else might be going on on your network at the time, so you miss out on the big picture.

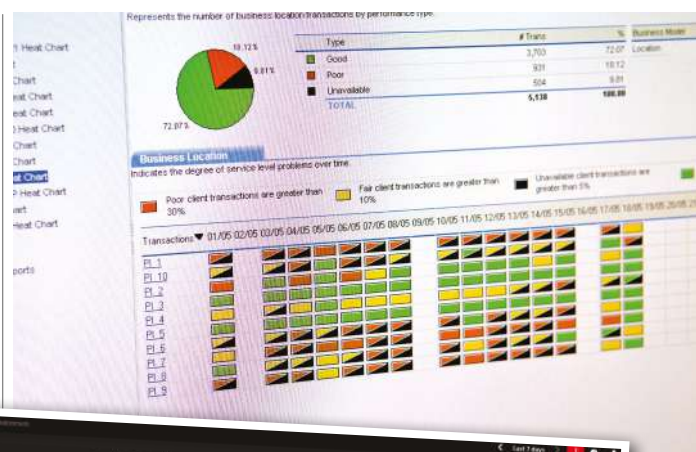
External monitoring, on the other hand, will show you the combined effect of multiple applications, services and virtual machines all running on one physical server. The catch here is the cost – as well as needing the expertise to deploy and manage the thing, the licensing fees for a premium monitoring suite can easily run to tens of thousands of pounds per year.

Monitoring cloud servers

The promise of the cloud is that you never need to worry about running out of resources, so it might seem slightly paradoxical that performance monitoring is a core part of cloud services. But it makes sense, because almost the whole point of a cloud of servers is that it can be scaled up or down at will, either intentionally by a human or automatically by a digital agent. For the latter to work usefully, the agent needs to know when more horsepower is needed or when capacity can be dialled down. That means tracking statistics such as transaction completion time, number of users now arriving, memory footprint of each user session, load on network channels and so forth.

Since cloud providers don't manage your actual workload, performance monitoring may be the only "live" service they offer, beyond the nuts and bolts of hosting. Statistics are continually collected from all points of the cloud architecture, be that a racktop switch, a gold master VM server image or a webcam pointed at a mercury thermometer on the wall.

They do this not merely to help you, but to justify their own business. If your hosting bill unexpectedly shoots up one month, or if your compute pool seems to keep gradually growing and growing, the provider can point to the numbers that confirm a spike in demand, or that point to the part of your application that needs debugging.



How deeply to monitor?

Although the technology exists to monitor your systems in the most exquisite degree of detail, setting up something like that is no trivial matter. And in a connected world, the issue could easily be outside of your visibility anyway. A thought experiment I like to propose to neophyte performance engineers is this: what would you do if you noticed a delay at the start of every YouTube video? I can monitor and manage the device that's exhibiting the behaviour – and I have some control over its internet connection – but I don't have

TOP Performance monitoring can instantly highlight IT problems

MIDDLE Dedicated monitoring tools can reveal a huge amount of useful data

ABOVE Monitoring allows cloud servers to scale themselves dynamically

To get the best results you'll need to engage with all parts of your computing estate

access to the upstream devices that may be involved in the delay. I can't check the YouTube servers, nor the cloud farms that serve up the pre-roll adverts, so what do I expect performance monitoring to do?

Even if your problem is internal, it may be trickier to resolve than you'd expect. Real networks are messy places: they have Wi-Fi routers where they shouldn't, cloud accounts shouldering business backbone loads paid for on the intern's credit card, and

a sheet of passwords in the drawer of the receptionist's desk. Simply sticking a pricey performance monitoring system on top of all that isn't likely to do you much good.

Rather, I recommend you start out with just one or two testable assumptions, and an appreciation of the sources and sinks of data in the system you want to monitor. Don't underestimate this requirement:

even if you try to keep things small scale, it can be dizzying to realise how much interplay is involved in an apparently simple app with a simple job to do. To get the best results you'll need a willingness to engage at the deepest levels with all parts of your computing estate, and there's a lot of "cognitive load" involved in boiling down all those log file entries, sensor reports and line-of-business events into something coherent.

Performance monitoring and AI

At this point you might be wondering whether this is an area where AI can help you cut through the mass of data and generate some quick, actionable insights. The short answer is yes, it can, but don't celebrate too quickly. Do you know how ludicrously vast the computing load of some AI systems can be? We're talking about electricity consumption bigger than some mid-sized countries: using 20,000 cloud VMs to run a GPT model isn't unusual. That might not be a consideration if you're paying a fixed £20 a month for ChatGPT, but it very quickly becomes a concern when the AI service is running on your cloud servers and you're paying for it all.

At the same time, there's nothing else out there that can do quite such an incisive job of boiling down the vast quantities of data created by a

performance-monitoring workload. Dedicated performance-monitoring systems can help you bring together all your log files and reports, and deal with collation, trend-finding and highlighting anomalies, good and bad. But GPT-type AIs are supremely versatile in their ability to summarise arbitrary quantities of data without really needing to know anything about how that data is structured.

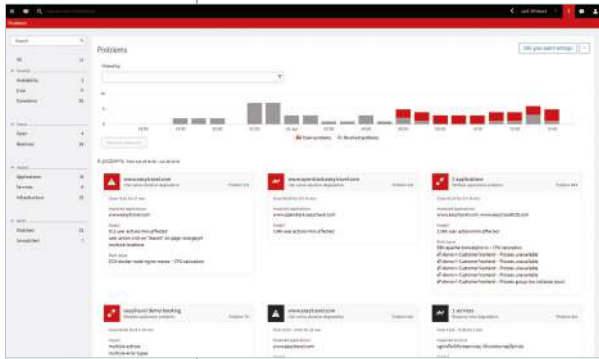
I remember early experiments in this field, running on a battered server running dual-Pentium 133MHz CPUs. Even with that minuscule quantity of processing power, it was possible to feed the machine a database file and come back the next day to be told what the top ten data values were in the top three transaction types. Using modern AI to munch through vast amounts of information might not be the cheapest way to skip the drudge work, but it can be a hugely effective one.

Brute force performance testing

This is a bit of an aside from our main subject, but when I'm talking about server-side monitoring, I find people often get curious about how exactly you test such systems. Business and IT types have understandable jitters about measuring system responses with live user workloads, but at the same time they want a testing scenario to be as realistic as possible.

The common solution is to use VMs to simulate large fleets of desktop PCs, all hammering the server at once with plausible but fictitious transactions, to generate a simulation of real-world loads. You might say accessing a cloud host from a real desktop PC is different to doing so from a virtual PC running inside that same cloud. That is indeed true, but the difference isn't as drastic as you might think. Let's say you're using AWS to deploy tens of thousands of virtual single-user PCs, all going through typical patterns of browsing, data entry and order processing. You'd expect this to produce a very unbalanced load, but the architecture at Amazon is smart (or fortunate) enough to sprinkle repeat instances far away from one another, to avoid hot-spots inside its semi-secret, slightly proprietary cloud architecture. The result is real-world chokes on bandwidth, routing and so forth that make the virtual clients somewhat representative of real PCs.

Testing in this way doesn't just provide reassurance in terms of data protection. While simply collecting statistics ought to be harmless and unobtrusive, most engineers have had experience with systems that mostly do what they're supposed to, but that exhibit other less obvious behaviours when working under duress. You don't want to expose real customers to those if you can possibly



avoid it; better to push the limits with a digital twin of your live system.

This only leaves unaddressed the issue of minority platforms – machines, operating systems and browsers that aren't represented in your VM cohort, perhaps because they don't take well to being virtualised. If they're cheap enough, there's a lot to be said for just throwing a few hundred of them into a rack, strapping them down with cable ties and building them into the otherwise virtual test suite.

Performance monitoring in the IT business

One last challenge I've repeatedly run up against as a consultant is when a cloud application doesn't expose any internal performance data to end users. This tends to apply to "as-a-service" offerings, such as web-based email, productivity and CRM tools. The slick, user-friendly presentation doesn't even acknowledge that the app is consuming network bandwidth, let alone report how much it's using.

Behind the scenes, however, the traffic stats, message sizes and so forth usually are being recorded – just not anywhere you can access. Your best way forward is to try to get the support team to send you whatever metrics they can. They probably won't be able to give you anything you can log into, nor even live information about the state of the service at. But they're often willing to help out a paying customer who's looking to do the legwork themselves.

If you want to curry favour, though, I recommend that you don't go in at the outset demanding a vast data grab to dig about in. A small set of logs from a specific time slice may well

ABOVE Log files can be hugely revealing – if you're able to decipher them

LEFT Find out quickly when services are unresponsive

be enough to get you into the right territory; often a very minimal diagnostic is enough to rule out a lot of potential bottlenecks or load issues. If you keep your own records of any particular times when there's an apparent problem, you can at least establish what the supplier wants to tell you about that period.

When it comes to looking at your internal systems, the pattern is different. I recall a case of this with one client, whose database and cash register support software were nimble and responsive right after startup, but would slow to a crawl by the end of the day. The IT officer became habituated to regular restarts to clear the problem – but this wasn't a quick fix, as the slower the database became, the longer the restart would take.

Eventually I had to go and take a look myself. The cause didn't take long to find, via the Windows Task Manager and Event Viewer. The server was running dozens of duplicate instances of a small logging app that had been designed to collect a few bits of diagnostic data for each transaction. Ironically, these logs might have been useful for performance monitoring; however, the system had been configured to launch fresh instances of the app at intervals sympathetic to the business workload, and had ended up spawning more than 80 overlapping instances, filling up the system RAM and putting huge queues into the storage array.

I didn't wait for any consent or interaction; I purged the launch schedule and allowed the system to work its way back to normal operation. There was no complaint about this from the support company, and my client went back to running his business instead of fretting over rebooting servers. This probably says more about the tunnel vision of some business app developers than about large-scale performance-monitoring apps in general, and the takeaway here is just what we mentioned at the start: performance monitoring is a varied field, with many different designs and approaches – almost one per incident. Engaging with this field is both inevitable, and at the same time far from business as usual. ●



Agentic AI

Are you ready for AI bots to start actively working in your business? Steve Cassidy looks at the opportunities – and risks

Not another sort of AI – is there no end to them?

None in sight yet! And while not all AI-related “innovations” are actually distinct and useful, agentic AI does deserve a label of its own.

To define our terms, “agentic” refers to the pre-AI concept of an agent – a piece of software that acts automatically, without requiring a human to click its buttons. Early agents usually took care of simple tasks such as installing updates or blocking viruses, following fixed rules or instructions beamed over the network, but the new generation of AI agents are far more autonomous. They can use multi-step reasoning, act proactively and even update their behaviour based on past experience.

So the AI just decides for itself what to do?

Not exactly: AI agents are usually tailored to specific tasks. One popular type is customer support agents, which can answer questions and give advice in a conversational manner. Other types of agent can keep watch over network security, manage production lines or pursue scientific research with a speed and persistence that few lab assistants can match.

This sounds like something you know a lot about!

Well, this is a hot topic for me, and for all IT professionals. Although we’ve been hearing for years about how AI is going to take our jobs, the likes of ChatGPT and Microsoft Copilot are more about improving a person’s productivity than replacing them altogether. Agentic AI, however, has the potential to completely upend employment practices, allowing businesses to eliminate entire employee functions and delegate them to software.

Roll your own AI agent

Some platforms already offer prefabricated AI agents: Salesforce’s Agentforce product, for example, can take care of customer service, sales development, employee training and research to boost productivity (see salesforce.com).

If you need something specific, though, you might need to build it yourself. You can do this surprisingly easily using any of the “big four” cloud providers (namely Amazon, Google, IBM and Microsoft Azure). As well as hosting your agent, these services can supply the necessary back-end smarts: for example, Google includes access to its own Gemini AI engine, IBM has Watson, and Azure – thanks to

What makes agentic AI so different to regular AI?

It’s not just that agentic AIs are designed to do a particular, practical job: the idea is that they’ll do it to somewhat professional standards. It’s considered good enough for a general-purpose LLM such as ChatGPT to operate as an opaque “black box” and generate output that’s plausible if not entirely accurate. Agents, however, are (or should be) held to higher, more tightly defined standards. One particularly desirable characteristic is that the decision-making process comes with a descriptive log, allowing humans to review the machine’s “thoughts” processes – providing an element of, if not accountability, then at least visibility.

Why has it taken so long for agentic systems to start catching on?

Good question. While ChatGPT has been with us for nearly three years, agents are only now gaining attention. This is partly because the idea of allowing a piece of code to directly control a real-world system, with no direct human oversight, makes lots of organisations understandably uneasy. There’s also the practical issue that there isn’t currently a standard interface for AI to control all our different technology systems, so you may not be able to easily deploy a neatly packaged AI agent into your existing IT portfolio – although you could always build one (see below).

How can I trust an AI that can learn and change its own behaviour?

Another good point. Any job worth doing needs to be done with a certain consistency, and this is something AI has traditionally been poor at. But if agentic provide justifications for their autonomous decisions, we can use those to guide them. They may also give us workflow insights that we’d never have picked up from human staff – which can in turn drive results that, if not wholly consistent, consistently improve. ●

Microsoft’s partnership with OpenAI – includes direct integration with multiple ChatGPT models.

Each provider offers custom tools for designing chatbots, along with frameworks for accessing and searching resources, so your agent can understand your business and find key information.

You don’t even need to be an ace developer to produce your agent: the code for this project (or any other one) can be generated and refined from an interactive online chat interface. Just be aware that “vibe coding” can produce unexpected behaviours – and relying on an external AI resource means you might get only a limited audit trail of its “reasoning”.

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Real world computing

Expert advice from our panel of professionals

JON HONEYBALL

“It caused a few ‘oohs’ and ‘ahhs’ at my local pub, which is one of my benchmarks for geek wizardry”

Jon has mixed thoughts about the Samsung Galaxy Z Fold7 after four weeks in its company, and is pleasantly surprised by vibe coding

I have been using the new Samsung Galaxy Z Fold7 alongside my daily-driver iPhone 16 Pro Max since it arrived a few weeks ago. If you listened to the *PC Pro* podcast episode 753, “We’re over 18 and we can prove it”, I had only had it in my hands for a few hours, and it was already making a very strong impression.

The first thing that struck me is just how stupidly thin each panel is. The hinge is far better than previous folding phone hinges that I’ve seen, and it’s actually hard either to see or feel the slight crease across the screen. Clearly an enormous amount of engineering has gone into this, and it looks and feels like a very polished product now.

The Android build works well, and there’s something almost magical about working on what appears to be a conventional phone, then folding it open to double the screen size. It certainly caused a few “oohs” and “ahhs” at my local pub, which is one of my benchmarks for geek wizardry.

So what’s not to like? Well the price is certainly robust, coming in at just under a couple of grand even for the base model. Battery life is adequate but certainly doesn’t shine (though that’s not unreasonable given how thin the two panels are). There’s no pen digitiser support, but I can’t remember the last time I used the pen on my Samsung S24 Ultra phone, so that’s no loss for me.

The cameras work well, but I’m far from convinced by the 200MP claims. The data is there in the file, but the quality doesn’t match the bit-size resolution. And I struggle to

understand why there’s such aggressive digital zoom. I know it makes for good reading of the spec sheet, but sometimes marketing must take a back seat to deliverable quality. And what’s the point of 8K video recording if the frame rate is 30fps?

But the biggest problem for me is the camera bulge. We’ve become accustomed to large protuberances on the rear of our phones, housing the ever more complicated camera lenses and sensors. And it’s never really bothered me on a conventional phone because I always have some sort of case protecting the sides and the rear. This usually does a reasonable job of covering up the bump.

It’s quite different with the Fold7. The whole point of this device is the magic of taking something that looks like a normal phone, that has comparable dimensions to almost



Jon is the MD of an IT consultancy that specialises in testing and deploying kit
[X @jonhoneyball](#)

any high-end device, and then unfolding it to a double-width and yet half-thickness tablet. The only term for that is magical. Now it sits very well in the hand, and is a properly effective mini tablet.

But when you place it down on the desk, a very likely use case, disaster strikes. The large camera bulge means it can’t sit flat on a table top. It wobbles around in a very ungainly fashion, and the magic evaporates in front of your eyes.

I could slap on a case, but that would ruin everything. The reality is that the camera bulge is both too big and in the wrong place. I would suggest putting the bulge to the side, next to the volume up/down buttons. I know this would be an unconventional position, but the necessity to work on a table top cannot be ignored.

BELOW The Fold7 is magical... until you try to lay it flat on a table





Jon Honeyball

Opinion on Windows, Apple and everything in between – p110



Lee Grant

Tales from the front line of computer repair – p113



Dr Rois Ni Thuama

Risk analysis from our expert in cyber-governance – p116



Davey Winder

Keeping small businesses safe since 1997 – p118



Steve Cassidy

The wider vision on cloud and infrastructure – p120

I would gladly give up some camera capabilities, too. You could argue that this isn't really a consumer product at all, but one aimed at work operation. Keeping two apps open side by side is a very strong work use case, as we saw on the Microsoft double-screen Surface Duo.

So I'm left with mixed feelings. Clearly the Fold7 is a state-of-the-art folding phone, and the large tablet screen size is extremely useful. The new hinge is a marvel, and I hope that the years of R&D will pay off in its robustness and reliability.

But it's a product without a clear purpose, and that is a big problem. It appears to have been led by an engineering push to make a super-thin, double-screen foldable phone with a state-of-the-art hinge mechanism. In that, it succeeds beyond my expectations. However, the "why?" and "what for?" questions are left unanswered, which is a pity.

ESIMs in the EU slow lane

I recently took a quick trip to Brussels by motorbike for meetings and to see old colleagues for dinner. I tend to take out an eSIM for the days needed and load that into my phone. It costs a few pounds and can provide useful backup if the roaming on my main SIM goes south. My default provider in Europe is Hologram. You get a data connection with no phone number, and loading it onto the phone is a matter of scanning the QR code that it sends. It really couldn't be simpler.

However, this time things weren't so straightforward. All the way through Netherlands, Belgium and then into France, the only connection I got was a slow LTE. Hologram claims it should be full speed, and it should work across those countries. Somewhat annoyed, I dropped back to roaming on my main SIM, which worked fine.

When I got back, I contacted Hologram support to ask why this was: its only response was that it offered eSIMs with LTE or higher speed, and the conversation petered out after that. I'm not sure what was wrong, and of course I had done the usual things like rebooting the phone to force the SIMs to renegotiate. In the end, using roaming on my main SIM worked fine and I'll use that in future. It doesn't cost much.

So why have the backup? Because I've landed in Europe and the USA before and my SIM didn't roam correctly, requiring a testy phone call to the support team to discover that the SIM which was supposed to have international roaming didn't actually have it. Sometimes I wonder just how broken the IT systems are of telcos. Along with airline systems, I suspect they're held together with glue and string. And that's being generous.

Vibe coding works!

I saw a tweet about a new generation of app builder, built around the principles of vibe coding. This appears to be where you tell an LLM about how you're feeling, what you had for breakfast, and whether you think England will win the cup. Then you ramble out a description of what you want the app to do, and the LLM magically writes the code for you. If you're lucky, the tool will compile and run it for you, too.

It sounds too good to be true – which in this case it was. The tool I looked at is called bitrig and can be found in the iPhone App Store.

What intrigued me is the claim that it can write an app for my iPhone using the native Swift programming language. It can then run the app on your phone, using the TestFlight beta testing environment, and you can actually deploy it. You get access to the source code, too. Some of this costs money, but the basic platform is available to kick around to see whether you think it's worth the subscription cost.

RIGHT I was prepared to be disappointed by vibe coding, but it actually seemed to work



ABOVE Roaming in the EU works sometimes but at other times doesn't

So I fired up the tool and told it I wanted it to write a journey-recording application. It should record speeds, and all the data points along the journey, and then present me with a map of the route taken.

Having pressed the build button, I sat back and waited to be disappointed. What I got was a fully working application, except the map part didn't appear on my phone at the end of a journey. In fairness to bitrig, this phone is running a late developer build of iOS 26, so it could be caused by any sort of beta wobbles. I'll give it the benefit of the doubt. I could see and scroll through the Swift code, and it certainly appears to have written stuff that looked coherent. I'll have to stump up some cash if I want to take the code and load it into the main development tools, or to use the bitrig capabilities to publish the app. But the whole idea is pretty crazy because clearly it does work. I'd be very nervous about pointing a tool such as this at some commercially sensitive data and asking it to write me an ERP platform from scratch. Or an accounts package. Perhaps, though, we're entering a new era of custom widgets that can do what you want, and they can be built in minutes with only a description of what it is that you need. That's a very interesting





development, and one worth watching. One more reason to be cheerful: bitrig's founders are seasoned Apple developers who know Swift intimately.

Another fine mesh

Here is an interesting problem I recently encountered with IoT devices on a mesh network. I was helping out a mate, which is always a bad start to the weekend unless beer is involved (it was). His outdoor security camera wasn't working well, often falling off the network. The front-door video doorbell was working fine, however, and his Wi-Fi and internet connections were set up well with no nasty co-channel interferences from rival networks.

So what was causing the problem? His home network is a Wi-Fi mesh, which uses Wi-Fi as the connection between the access points. It was a reasonable one, too, giving good service and perfectly acceptable for his needs. Firing up the phone app immediately showed a problem: the outside camera was trying to connect to the wrong mesh access point. By "wrong" I mean it wasn't connecting to the mesh unit closest to the camera, but to the one furthest away. No amount of rebooting the camera would seem to get it to wake up to its predicament and get it to join the nearest unit.

Some firm action was clearly required. Most mesh systems will tell you which device is connected to which mesh unit. I would rate this functionality as critically important. Once you know this, you want to be able to select that device and force it to use a specific access point. There's no need for roaming capabilities across the mesh for a fixed IoT device like a camera or doorbell, so it's a good idea to nail down any such devices onto the best mesh access point appropriate to that device.

Once I'd done this, and rebooted a few things just to be sure, the camera connected to the nearest and most appropriate mesh access point, and sanity had returned.

Of course, for more serious networks, you can do this same trick. Or just set a specific SSID and password for that particular requirement and join the IoT device to that. I did this at home, setting up a 2.4GHz SSID that only appears on the access point that's in the kitchen. To this I join the dishwasher and air-conditioning controllers. Oh, I set up network isolation too, so that although the dishwasher can join the Wi-Fi network and access the internet, it can't see any other devices on the network whether they're wireless or wired. This sort of partitioning should

be very simple to do; with UniFi, it takes one mouse click to enable it.

If you're running a mesh and having problems with fixed devices appearing to fall off the network, it might be worth using a big stick and knocking them into submission.

Synology and its certified drives

The dust appears to be settling on the story of Synology and its list of acceptable drives that can be used in the latest 2025 NAS units. You'll recall that Synology said that the new NAS units would only work with certified drives. However, there was a big caveat with that: you can migrate an existing set of disks from an older Synology NAS to a new 2025 series unit.

The problem comes when you want to add drives or to replace one of the existing drives. At this point, you can only use a certified drive, and it won't accept a non-certified drive.

So what counts as a certified drive? You will be shocked to hear that this is a drive sold by... Synology itself. There are, as far as I can tell, no third-party drives from well-known companies such as Seagate or Western Digital that are appropriately tested and thus blessed. When Synology announced this new policy, it said that certification will be coming, but it was up to these third-party companies to do the certification. So far, it hasn't happened.

It's hard to know who to point the finger of blame at. First, the obvious and immediate reaction was that this was an outrageous step by Synology. How dare it basically require you to buy Synology drives for the 2025 models? Well, it had done this for the rack-mount big-boy boxes several years ago, claiming that reliability was a big issue, and the support costs

ABOVE Fixed devices such as cameras don't need roaming capabilities on a mesh

"The problem for Synology is that the clock is ticking. At some point something will have to give"

BELOW Synology is continuing to insist you use its own drives in its 2025 NAS devices



to Synology meant it had to lock down the hardware to tested drives.

But to bring this to the mid-range Plus series was clearly a step too far.

I'm pretty annoyed that the certification process hasn't proceeded as quickly as it should. Maybe the third-party drive manufacturers simply don't care. Maybe Synology has been obstructive.

But there might be an underlying issue. Now this is pure speculation, but bear with me. Synology would know what the issues are with third-party drives in its NAS boxes. Is there a big unspoken problem here? For example, updating firmware on drives is something that almost no-one does, but when it does happen updating the firmware via a NAS box isn't a simple task.

What if a particular model of a drive range is actually unreliable? Remember that NAS units push drives a lot harder than a typical desktop or laptop, if only because they're usually running 24/7. Are some drives showing up as a problem? I don't know. Backblaze publishes statistics on all the drives it's using in its large installations and it makes for fascinating reading, but this obviously only covers the drives that it's using.

The problem for Synology is that the clock is ticking, and the lack of certified third-party drives is now becoming a big issue. It either has to get drives certified, or pull this harsh requirement about no installation of uncertified drives. For myself, if I wanted to have a 2025 model Synology, I would go with the Synology own-brand drives. Life is too short to start getting involved in an argument in a support call about which make of drives are in use. And the Synology own-brand drives aren't priced at an offensive level.

At some point something will have to give. I still love the Synology platform and have yet to see anything from another vendor that comes close to its breadth and capabilities. If you just want raw SMB storage, then the UniFi Nas Pro is a better bet if you're on the UniFi platform. But Synology's NAS devices are a lot more than just plain storage.

Anyway, the issue rumbles on with no solution in sight. This isn't good news for anyone.

 jon@johnhoneyball.com

LEE GRANT

"The laptop wasn't pretty. Beneath the chalky corrosion was damage like I'd never seen"

It's time to ask important questions: are you too drunk for Windows? Does Microsoft own a phone? Should one die or a pay a bill?

I've thought of an AI enhancement that Microsoft should roll out with indecent haste. It's a derivation of the ignition interlocks that can be fitted to cars so the driver has to pass a breath test before the engine will start. My Microsoft proposal is to let Copilot use webcam and/or microphone data to detect if a laptop user has just uncorked an agreeable Cab Sav or nosedived into a hot chocolate with marshmallows. At the first hint of "liquid-crime", Copilot's AI terminates 95% of the machine's power, while the remaining 5% is used to play "Crazy Frog" (tinyurl.com/374crazyfrog) on an uninterruptible loop. Only a few months ago (see *issue 372, p115*) I warned about liquids and laptops, but clearly the message isn't getting through.

When Mr Jones quipped that he'd had a Sémillon while using his laptop, I completely misunderstood. He finally explained that his laptop had gone bang after a glass of white wine entered the keyboard.

The laptop wasn't pretty. Beneath the chalky corrosion (removed with some isopropyl alcohol) was damage like I'd never seen. Soldered to the motherboard were various sizes of Surface Mounted Component (SMC), which require a microscope for a visual inspection. Usually, a crack or split along the body of the SMC



Lee Grant and his wife have run a repair shop in West Yorkshire for over 20 years
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"Mr Jones certainly wasn't exaggerating about the noise the laptop must have made"

BELOW White wine and tiny components tend not to mix well

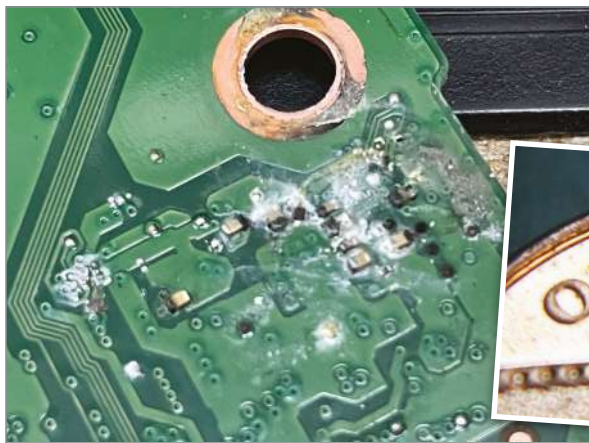
gives a hint of where the epicentre of the problem is located. Mr Jones' SMCs had blown apart, leaving just the dielectric body dangling from a single tin solder joint.

If it helps you to visualise, imagine one of Mr Jones' SMCs as a Christmas cracker which has just been pulled. Sitting at the table is Grandma, holding her end of festive fun because she won the pull. Where Grandpa should be sitting, laughing inclusively at his bad luck, is a smoking square of Axminster. The cracker malfunctioned to such an extent that Grandpa was blown backwards through the lounge wall, never to be seen again.

Mr Jones certainly wasn't exaggerating about the noise the laptop must have made. The wine had landed directly on a power management chip, a Texas INA231. Its job is to monitor the voltages and act accordingly in case of an anomaly, and as a pinch point for the different power rails running inside the machine.

I know about this only through luck. As I've mentioned many times before, laptop manufacturers don't provide any documentation that explains which SMCs they've used to make a circuit board, and this makes repair virtually impossible. Such proprietary information exists, but it's locked away in a drawer marked top secret, defended by three ninjas and the DMCA.

Fortunately, some information seeps onto the internet, and Mr Jones was lucky that a usable schematic





had blown into a dark corner of the web. I could probe around with a multimeter with some idea of what I should find, and I replaced 15 SMCs, with nine of them being the microscopic 0201 package. These are named because their dimensions are 0.02 x 0.01 inches (0.6 x 0.3mm), so soldering a glut of them to a circuit board is a frustrating way to spend an afternoon. I don't know how many I lost during the process. Once I'd extracted a 0201 from its packaging and got it somewhere near a solder pad, a simple tremor of the hand was enough to ping it across the workshop.

After all that, did I fix the laptop? No. I'd already chatted with Mr Jones about costs, warning that even if the circuit board was repaired, then the keyboard would need replacing (the keys were very sticky). I was at the workbench with another 0201 between my tweezers when Mr Jones called to say that he'd rather buy a new laptop. I didn't argue.

So once again, the moral of the story is to keep liquids away from electronics, but it's also a reminder that despite the legal shove towards more meaningful right-to-repair legislation, manufacturers still aren't publishing the schematics for its products (with the exception of Fairphone, as you'll discover at tinyurl.com/374fairphone).

The next time you're buying a product, ask about repair manuals, schematics and spare parts. The more times retailers are asked, the more likely it is that these odd requests will travel up the chain to wholesalers, distributors and manufacturers. We're probably urinating into the breeze, but it won't cost us to try.

Is Microsoft still asking the wrong questions?

Continuing the theme of repeating myself, we come to Paul. Since we opened in 2003, we've supplied Paul with several PCs, handling data transfers and all the usual services you'd expect, including Microsoft Office. Back in 2015, Paul switched to Office 365 Home (as it was called at the time) and since then an annual alarm goes off in our shop when it's time to renew Paul's licence. This process is simple. I walk to the front of the shop, grab a retail copy, slice it



ABOVE Locked out: Paul only used his Microsoft account for Office 365 and Teams

open and remove the key card. I then log into Paul's Microsoft account and input the number before logging out.

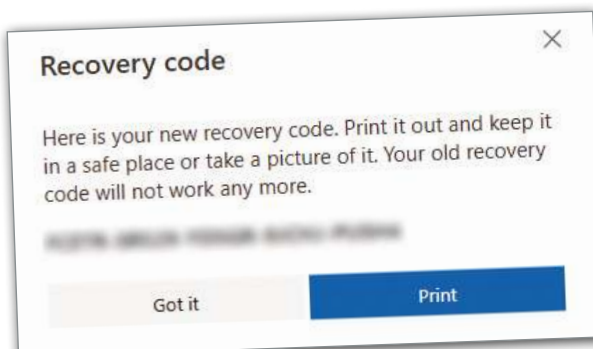
We've repeated this process every year since 2015, but this time we hit a snag. When I logged into Paul's account, a warning popped up explaining that the account had been temporarily locked by Microsoft, pending the input of a code. This code was going to be sent to the email that Paul inputted when he created the Microsoft account prior to 2015. It won't be a surprise to most *PCPro* readers who will have already predicted that Paul no longer had this email address. Microsoft's lockout code would never arrive.

I last wrote about this almost three years ago (*see issue 346, p111*), and what remains true is that when Microsoft pulls up the drawbridge, it is very difficult to persuade it to lower said bridge again. This is for good reason. Microsoft may ask a user to re-verify their credentials. Its platform, its rules. If a user can't do this, then Microsoft needs to employ maximum caution to avoid giving an imposter the keys to someone else's kingdom. On the flip side, for those like Paul who attempted the "Forgot password" procedure more than once and failed that version of validation, Microsoft needs to make it much simpler to talk to a real human being.

Paul's Microsoft account is only used for Office 365 renewals and Teams. There's no Microsoft login

"Microsoft Dan eventually dropped me a line. Then it all got a little strange"

BELOW A recovery code could help you get back into a Microsoft account you can't access



to Windows, no Outlook.com email, no Xbox use, no OneDrive storage or Copilot slop. Paul didn't pass Microsoft's tests because its account recovery process presumes these services are in use. For example, if Paul used Xbox, he could give recent gaming history, or his Outlook.com could

validate against a string of recent recipients. Understandably, the chances of revalidation rocket if Microsoft has data to work with. Users who can't answer this narrow band of questioning are in trouble.

Paul could have set up a new email account to run Office 365, but that would entail giving a different email for Teams, and at that point life gets messy. That plan would go on the back burner while I contacted Microsoft's press office. It took three attempts to get a response, but Microsoft Dan eventually dropped me a line. Then it all got a little strange.

Microsoft contacted Paul and a four-way conference was organised for me, Paul, Microsoft Dan and Microsoft Susan* from Executive Customer Relations. During this call, I explained the simple situation and Microsoft was genuinely keen to help. Microsoft Susan was assigned to the case and I was sent two alternative forms to complete on Paul's behalf. Both Microsoft Dan and Microsoft Susan emphasised how important it was that I told them everything I knew about Paul's Microsoft account, and I didn't disappoint.

I told them the IP addresses used when connecting to the accounts, I also sent them dates the password was changed, the date the email address on the account was changed (and what it had been), no-longer-used Skype contacts and a complete list of subscription renewal dates from 2015 to 2024.

What's interesting is that none of this information is asked for on the standard Microsoft account recovery form. In these cases, specifically involving Office 365, neither of the forms Microsoft provided asked me to provide the email address of the person with whom Paul had shared his Office 365 account. This person, who is Paul's partner, has been connected to the locked account since 2020. Surely a "do you know

this person?" could be implemented to help grease the wheels.

After a few days, I received a phone call from Microsoft Susan. She took control of my PC and together we accessed Paul's account, updated the password and removed the ancient verification email address. Thanks to her, Paul regained access, and later that afternoon, we implemented 2FA using Microsoft Authenticator, so the next time Microsoft's verification fairy drops by, they won't put us on the naughty step. Microsoft also gave Paul two months of Office 365 for free as an apology.

How to protect your Microsoft account... from Microsoft

Naturally, being a *PC Pro* reader means that your Microsoft security information is up to date and this would never happen to you, but just in case things may have slipped, then Microsoft Susan, despite not being part of the official Microsoft Press Team, sent over some links for me to share. Some you'll know, but I bet you don't know them all.

First, enable two-step verification (tinyurl.com/374twostep), then add more security information (tinyurl.com/374secinfo) and use Microsoft Authenticator (tinyurl.com/374authy). Also, add a trusted device to your account (tinyurl.com/374trusted) and finally, generate a Microsoft account recovery code (tinyurl.com/374recovery). Hands up, I didn't know that last one existed either, but this code works like a standard 2FA bypass and could get you back into your Microsoft account should things go awry.

I raised Paul's case with Microsoft because it is far from unique and highlights a significant problem in Microsoft's customer-facing operation. For this article, I asked Microsoft Dan many questions, including why there isn't an easier way for consumers to contact a real Microsoft support agent who can investigate cases. Microsoft has chosen not to answer these questions. Interestingly, Microsoft Susan was surprised to hear that users struggle to speak with anyone inside her organisation that can help and this is telling. As consumers continue to get kettled into non-local logins and OneDrive backup traps, it's vital that Microsoft ups its game. Another of my clients is also locked out of their Microsoft account, and this has led to a devastating loss of the data.

The motherboard on their laptop failed, but the SSD was encrypted by

Windows 11 during setup. The customer has no awareness of this process or visibility of the decryption key, which was auto-uploaded to their now-locked Microsoft account. There's an argument to say that this customer should have a better backup setup, but it's also true that Microsoft's poor account recovery system shouldn't affect an innocent user getting access to locally stored data.

What's clear to me is that Microsoft is still not prioritising account recovery, so stave off a world of pain and frustration by spending ten minutes implementing the steps suggested by Microsoft Susan.

Goodbye, Mr Turner

Last month I was asked to update a graphics card to cope with *The Elder Scrolls IV: Oblivion Remastered*. This seemed like a simple upgrade before realising the new GPU didn't fit, even after carving out the case with a "popular rotary hand-held power tool". Eventually, the customer bought a new case, GPU and PSU and then played the game twice before inconveniently dying without paying their bill. I mention this not only to highlight the financial perils of tech-retail but to say that the customer, Geoff, was Alison's father and her love of technology comes directly from him.

Geoff was a science teacher and, as was usual in the 1980s, he was charged with doing something with "that computerised thing" which had been delivered to the school. Geoff loved technology, inspiring hundreds of kids to think positively about computing by creating practical projects such as a bulletin board system for the building.

He also dabbled with coding



ABOVE/BELOW The "Down at the Mac" site is just one small part of father-in-law Geoff Turner's legacy

"In the name of Geoff Turner, let's raise a glass to all the trailblazing teachers"

adventure games, getting some published in magazines. When he retired, he grabbed a FrontPage 98 manual and built "Down at the Mac", a popular community website for his fellow Huddersfield Town fans, which still exists today for Terriers' fans to grumble about awful on-pitch performances.

Geoff loved the history of technology and had been keen to read Tim Danton's new book, *The Computers that Made the World*, so aside from the personal loss to our family, *Oblivion* has lost a fearsome dragon slayer and Tim has lost a sale.

Like countless of his teaching peers, Geoff pioneered the use of computing in education. Many *PC Pro* readers, myself included, had a career-defining moment at the keyboard of their school's BBC Micro or Acorn Archimedes, sitting next to a teacher buzzing with enthusiasm. So, in the name of Geoff Turner, let's raise a glass to all the trailblazing teachers whose passion lit up the screens of the 1980s, sparking a love for computing that powers the world today.

**PC Pro* has changed Susan's name. Not at Microsoft's request, but because her real name is rather unique, and to protect her from being inundated with requests for help.

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ROIS NITHUAMA

“If your security training is boring, it’s not doing its job. This stuff is existential”

Training is the legal risk you’re probably sleeping through, but do so at your peril if you work in the field of information security

Ugh. You can almost hear the thud as hearts drop when anyone mentions “information security”. I’ve written before about the inescapable boredom of online training that treats participants like oxygen-deprived guinea pigs in some dystopian experiment. This is a fresh new hell. Combine the words “infosec” with “mandatory training” and you’ve brewed yourself an elixir for deep sleep, bordering on a 1 on the Glasgow Coma Scale. I’m sorry to report, I’ve seen it first hand, delivered by one of the world’s dullest curmudgeons.

The subject matter isn’t the problem. Crime fiction sells, police procedurals rule prime-time TV, and audiences binge on tales of fraud, blackmail, insider betrayal and big-ticket theft – exactly the risks information security exists to stop.

So how do we take material that’s dripping with jeopardy and consequence, and somehow turn it into corporate Ambien? If your security training is boring, it’s not doing its job. This stuff is existential: get it wrong and the business closes. Get it badly wrong in critical national infrastructure and we’re all lining the streets with buckets for water.

When training is bad, organisations don’t just waste time and money – they create legal risk. The regulator’s question doesn’t end with “did you do training?” The follow-up is “was it fit for purpose?” And if the answer is no, they can (and will) use that as a lever to find against you.

That finding isn’t just embarrassing but is actual evidence. Evidence that can be used by anyone with a claim against you, from customers to shareholders, and at that point the regulator’s done the heavy lifting for them. The civil litigation bus starts rolling, and it’s your business under it.



Rois Ni Thuama is a consultant specialising in risk management and corporate governance.
[X @rois_cyberstuff](#)

“When training is bad, firms don’t just waste time and money – they create legal risk”

BELOW Dull training sessions aren’t just a bore for participants, they can put your business at risk

The myth of the tick box

Let’s start with the biggest misconception about corporate compliance: that once you’ve ticked the box, you’re safe. The assumption is seductive. “We did the training, job done, regulator off our back.” It’s also dangerous nonsense.

Why? Because regulators don’t stop at “was it delivered?” They might ask to review it. Pray your trainer isn’t blathering on about phishing for 30 minutes. The regulator might ask: did it address the actual threats your business faces today? Did it prepare people to make defensible decisions under pressure? Was there independent challenge to ensure the content wasn’t just reinforcing blind spots? Were the tools, methods and resources taught appropriate for your operational environment?

If you can’t answer “yes” to all of those, you’ve got a compliance gap – and the regulator will surely find it.

Fit for purpose?

Under regulatory frameworks such as the Network and Information Security Directive 2 (NIS2), the Digital Operational Resilience Act (DORA)

and even sector-specific rules from the likes of the FCA or Ofgem, training must be “appropriate” and “proportionate”. That’s legalese for it must work for *your* business.

Regulators increasingly treat training as an operational control, on a par with firewalls, incident response plans or backup systems. If you wouldn’t install a firewall that wasn’t fit for purpose, why would you accept training that’s not?

This is how it will play out with the regulators. The firm is technically compliant – they did run training. But when the regulator digs deeper, they find that no, it wasn’t tailored to the firm’s risk profile. That no, the senior leadership didn’t apply a consistent decision-making framework and yes, the business failed to address known significant threats.

This isn’t just a slap on the wrist. A finding that training is “not fit for purpose” can form part of an enforcement decision, which then becomes public record. And that’s where your legal trouble really begins.

From regulator to civil court: the domino effect

A regulator’s decision doesn’t just live in their archive: it’s a public document and will be read with interest by lawyers who represent people who may find they need to recover losses they incurred. For the claimant’s argument to succeed they must show that their losses arose as a direct result of the act or omission they’re complaining about. Moreover, that act or omission must necessarily have been reasonably foreseeable and avoidable. So, if investor losses arise because a meteor hits the planet,



while that may have been foreseeable Armageddon-style, it isn't necessarily avoidable. Point is, not everything that is foreseeable is avoidable.

Now the claimants don't have to prove that the directors failed to exercise reasonable care – the regulator already did that for them by reporting that the training wasn't fit for purpose. All the claimant's lawyers must do is show that the losses arose because of the failure to undertake proper training.

That makes litigation cheaper, faster and lower risk for them – and far more likely to succeed. Which means your “meh, it's just training” attitude could cost you twice: once in fines, and again in damages. You'll be lucky if you're still in the game.

Where a regulator has already recorded that your training wasn't fit for purpose, claimant lawyers inherit a roadmap. They don't need to relitigate the standards: they need to connect your failure to train properly with the loss.

That makes claims cheaper, faster and lower risk for them – and far more likely to succeed. Which is why a “meh, it's just training” attitude can cost you twice: once in fines, and again in damages. Have you spotted the pattern? Training isn't a box to tick: it's Exhibit A.

The false economy of bad training

The truth is that bad training is worse than no training at all. With no training, at least you know you're exposed, and you haven't wasted cash on training that won't help your business. With bad training, you lull yourself into thinking you're covered. The regulator calls that “wilful blindness” and courts won't tolerate it.

Training devised by the unqualified or under-qualified may be cheap, but they don't teach your people to recognise or handle the threats you face. Worse, they generate a false paper trail – “Look, everyone passed the test!” – that collapses the moment anyone asks if the test mattered. Not only is your competence in question, so is your integrity.

And here's the kicker: in regulated environments, “cost-effective” training that fails to meet legal standards isn't cost-effective. It's an own goal. You save a few thousand on licensing fees but you lose millions in enforcement, litigation and lost trust.

So, what does good look like? Regulator-proof training is evidence-ready training. It's risk-based, role-specific, scenario-tested,



independently assured and fully documented. When someone asks, you can show not only that people learned, but that the organisation acts differently as a result.

You need to show that the content is moored to your services, risks and dependencies. That it was no “Attendance only” exercise, with no assessment, no scenarios, no remediation, no playbook. Training isn't exposure to information: it's deliberate, repeated practice that builds the ability to do what's needed when it counts.

Board-level responsibility

Training isn't an IT problem; it's a governance problem. The skills and qualifications that lawyers, risk and governance specialists bring are essential to build defensibility.

Under laws such as NIS2 and DORA, senior management is explicitly responsible for overseeing cybersecurity risk and ensuring staff are trained. The task can be delegated to legal, compliance and/or HR, but the responsibility cannot.

A board must be able to explain how training decisions are made, how their adequacy is tested, how results are documented for defensibility, and how training connects to operational readiness and resilience. If it can't, the board itself becomes a target.

ABOVE You should be able to prove that training sessions are relevant and effective

“The uncomfortable truth is that bad training is worse than no training at all”

It's also part of a business strategy, so naturally falls under the board's remit. You should think of training like any other high-value control: it should be tested, adapted and funded accordingly. Done right, it can reduce incidents, improve compliance and even help in court. Done wrong, it's a liability that accelerates your downfall.

The difference isn't in the delivery format – in-person, virtual, recorded – but in the design, independent validation and legal defensibility. Regulators care about outcomes, not whether your people clicked through a slide deck in a coffee-fuelled haze.

If you want training to protect you – legally and operationally – here's a starter: map it to your significant threats, legal duties and contractual obligations (including what you owe customers and your insurer).

Document every stage so you can defend it under scrutiny. You don't have to get everything perfect; you do have to show that, at the time, your decision was reasonable given the circumstances. What's “reasonable” will differ from business to business.

The final word

Most mandatory infosec training is tick-box theatre. It's generic, forgettable, impractical and not actionable. It looks like compliance until something goes wrong.

Training should be memorable, practicable and compliance ready. When things do go wrong, you want to say – with proof – your training was relevant, current, independently validated and effective. You want to show the regulator you took your duties seriously and stop a claimant's lawyer in their tracks by showing that your training was fit for purpose.

Bottom line: a regulator's finding that your training failed isn't the end of the story, it's the beginning of someone else's lawsuit.

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The documentation defence

One of the most overlooked parts of compliance is the paperwork behind training. To a regulator, what isn't documented didn't happen; if it's documented but not implemented, that's a lack of discipline. Keep records not just of who attended, but also why the content was chosen, how it maps to your legal and contractual obligations, when it was last reviewed and updated, what independent review was carried out, and what measurable improvement it produced. If you can't produce this on demand, you're exposed. The regulator will want to see that the training was pitched at the right level for the right people at the right time.



DAVEY WINDER

“Don’t dismiss this as someone else’s problem, as doing so could mean it soon becomes yours”

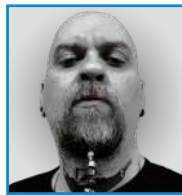
What on earth are Device Bound Session Credentials, and why do you need them? Allow Google, with a certain amount of help from Davey, to explain

I imagine a threat actor who can not only read a user agent, but who can also tamper with it. Now imagine that again, but this time understanding that a user agent can be your web browser. In this case, your web browser that has been compromised by malware.

Don’t dismiss this as someone else’s problem, as doing so could well mean it becomes yours soon enough. Malware capable of reading and modifying browser memory, as well as accessing stored secrets on disk, is both commonplace and increasingly popular in attacks. Google’s senior director of product management, Andy Wen, recently confirmed as much when he published a warning that, across 2024, Google two-factor authentication bypass attacks had risen by an astounding 84% (tinyurl.com/374google). A trend, Wen said, that has intensified during 2025. “We’ve seen an exponential rise in cookie and authentication token theft as a preferred method for attackers,” he warned Google users.

With attackers intensifying these credential theft attacks, and phishing obviously playing a major role in the initial compromise, it’s hardly surprising that Google is encouraging users to adopt passkeys instead of passwords; surprising, but hardly new. What is new is what Google referred to as an “enhancement” in this passkey support for more than 11 million Google Workspace customers, which brings expanded admin capabilities to the table.

These expanded capabilities take the form of being able to audit the enrolment of passkeys and restrict their usage to physical security keys. All good stuff, you say, but hardly exciting. Okay, so I’m a geek, the clue is in my email address, which is why I



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“In 2024, Google 2FA bypass attacks rose by an astounding 84%”

BELOW Google’s DBSC has got the geeks excited

do find the second announcement by Wen really quite exhilarating. Sue me.

Once again, we’re talking about something for paying Google Workspace customers, in the shape of an open beta of Device Bound Session Credentials (DBSC) to defend against precisely the type of 2FA cookie bypass attacks already mentioned. The reason for my (perhaps overly exaggerated for literary effect) excitement is that DBSC is about securing your account after sign-in.

2FA bypass attacks

It would be nice to think that, if you already have 2FA in place, protecting your account login with a second authentication step would be all the protection you need to prevent your account from being hijacked by hackers. Nice, but wrong. Welcome to the world of 2FA bypass attacks, or more accurately, session cookie theft attacks. A session cookie containing a flag that states 2FA has already been completed, and so access is allowed. This cookie is all the proof needed that the browser session has been correctly authorised and is good to go.

Here’s the really concerning part, though: once an attacker has hold of a session cookie, they can come back time and time again, effectively re-running that 2FA process at leisure and without the need for your actual 2FA code.

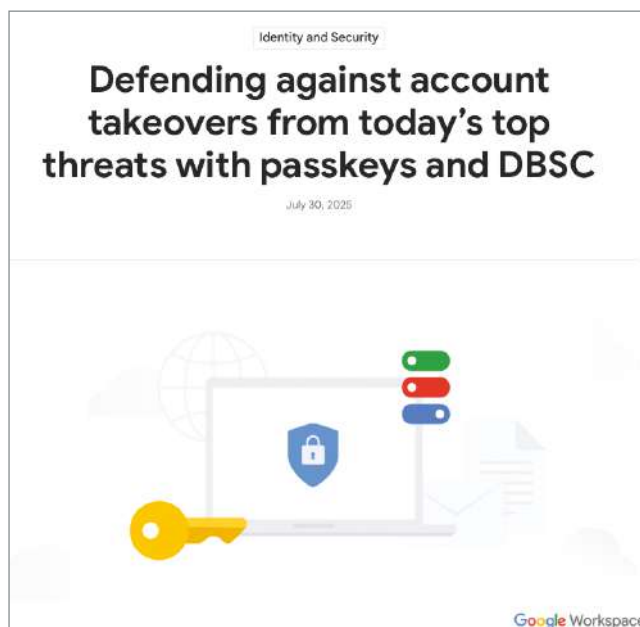
DBSC can help reduce the risk of session cookie theft-based account hijacking with the use of a protocol and browser infrastructure that both maintains and proves the possession of a cryptographic key. “On desktop operating systems, application isolation is lacking, and local malware can generally access anything that the browser itself can,” Google said, which is problematic as the browser must be able to access cookies to function correctly.

Authentication with a private key, on the other hand, provides system-level protection against key exfiltration. It isn’t difficult to see the issue when using cookies as an authentication mechanism then: they only lend themselves to what are known as bearer-token schemes. Bearer tokens, opaque strings with no meaning to the client using them, are fundamentally risky if you ask me. There are just so many things that can go wrong, especially when it comes to them being used by someone with malicious intent. Storage in an insecure location, security vulnerabilities in services employing them and, of course, the aforementioned attackers using phishing to reveal the token in the first place.

As Google’s Wen explained, DBSC provides users with enhanced post-authentication protection. This is accomplished by helping to make certain that it is only the originating device that access an active session. “More granular account attributes when used together with context-aware access” provides much stronger session integrity, Wen explained, “even if an attacker obtains login credentials after the initial login.”

Google has published a helpful explainer (tinyurl.com/374github) in the GitHub repository for Device Bound Session Credentials. Perhaps the most apposite paragraph is the following, which I have repeated in full here:

“DBSC is bound to a device with cryptographic keys that cannot be exported from the user’s device under normal circumstances, this is called



device binding in the rest of this document. DBSC provides an API that servers can use to create a session bound to a device, and this session can periodically be refreshed with an optional cryptographic proof the session is still bound to the original device. At sign-in, the API informs the browser that a session starts, which triggers the key creation. It then instructs the browser that any time a request is made while that session is active, the browser should ensure the presence of certain cookies. If these cookies are not present, DBSC will hold network requests while querying the configured endpoint for updated cookies."

Unfortunately, though, DBSC is not a silver bullet, as there are no such things in the complicated world of cybersecurity. Google itself has conceded as much in confirming that this protection cannot and will not "prevent temporary access to any browser sessions while the attacker has ongoing access to a compromised user-agent". But that doesn't mean it's a pointless exercise, and DBSC should be employed wherever possible, as it does add a weapon to your session cookie theft armoury. Namely that long-lived access is not possible for established DBSC sessions. "If an attacker has malware running within a victim browser process," Google explained, "they should be unable to continue to authenticate as the victim browser once that malware is removed." Again though, disclaimer incoming: the definition of long-lived depends entirely on the configured session cookie refresh period.

The takeaway? Session cookie theft is, without a shadow of a doubt, a critical compromise threat and one that has evolved to become a mainstay of account hack attacks. "To enhance security and prevent account takeovers stemming from phishing and infostealers," Wen concluded, "we recommend customers enable passkeys and DBSC immediately."

Google turns the screw

It's been quite a busy period for Google security announcements, and I'm not referring to the usual round of Chrome vulnerability reports and Gmail attack warnings. Instead, I mean by way of security improvement announcements, such as the DBSC enhancements, and transparency changes when it comes to Google's Project Zero vulnerability disclosures.

Let's start with what the heck is Project Zero, shall we? Simply put, it's Google's team of elite security

researchers who have been tasked with uncovering zero-day vulnerabilities. Not just within Google products and services, mind, but any zero-day vulnerability that might impact its users.

Launched in 2014, Project Zero has become one of the flagship vulnerability hunting platforms out there. One reason for this is the strict 90-day vulnerability disclosure window that was employed. This deadline meant that if the vendor in question had not patched the vulnerability within 90 days, then Project Zero would disclose it.

Things get more complicated if a vendor does release a patch, in that Google will then disclose the vulnerability 30 days after that date. If, however, a patch will be made within 14 days of the 90-day deadline, upon request, Google might extend the 90 days to 104.

This might all sound like a very bad idea, given that zero-day issues have led to some of the most consequential cyberattacks and data breaches across the years. However, bear with me: 90

ABOVE It's been a busy period for Google security announcements

"DBSC is not a silver bullet, as there are no such things in the world of cybersecurity"

BELOW Google has also changed its vulnerability disclosure policy



days – three months, in other words – is ample time to use the research already provided by Project Zero to implement and distribute a fix. And if it isn't, the vendor concerned really needs to up its security game and maybe adjust its business priorities.

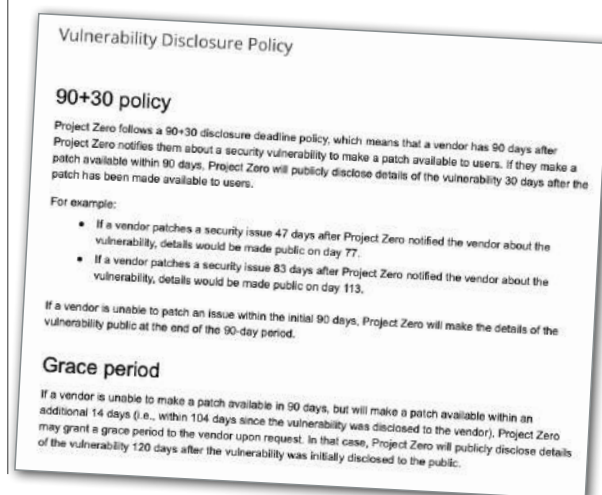
Project Zero has now announced an update to its transparency policy. While this doesn't alter the 90 days a vendor has to issue a patch, it adds a new step at the start of the process.

With immediate effect, Google Project Zero will now publicly announce that a vulnerability has been discovered within a week of reporting said zero-day to the vendor. That announcement will include the vendor, or open-source project, that has been notified, the product that has been affected and when the 90-day deadline expires.

The patch gap challenge

Tim Willis, head of Google's Project Zero, says that the changes are necessary to address the challenge of the so-called patch gap. I've always thought of this as being the threat window, that period between a patch being released and the user actually installing it. While that window is open, an attacker has the opportunity to strike using what is now a known vulnerability.

Willis, however, reckons that the work at Project Zero has identified a new problem that involves the patch gap, one that comes earlier in the whole process. It's what Project Zero is calling the upstream patch gap. "This is the period where an upstream vendor has a fix available, but downstream dependents, who are ultimately responsible for shipping fixes to users, haven't yet integrated it into their end product," Willis





Continued from previous page

explained. I mean, if that sounds somewhat complex, I guess it's because it is.

Much of Project Zero's recent work has been around chipsets and the drivers that they require, which are foundational upstream technologies if ever there were. Any delay in fixing a vulnerability upstream like this will, Willis hopes, significantly extend the vulnerability lifecycle. That's not complex, it's as straightforward as it comes: unmatched vulnerabilities are bad, m'kay.

So, by introducing this reporting transparency trial, Project Zero is hopeful that it can shorten the vulnerability chain. A patch released by vendor A to vendor B doesn't fix a vulnerability; the end user must still download and install the update on their device. "We hope that this trial will encourage the creation of stronger communication channels between upstream vendors and downstream dependents relating to security," Willis concluded, "leading to faster patches and improved patch adoption for end users."

Could this help attackers?

For my part, anything that makes it easier for both researchers and the public to track how long it takes for a patch to get from the original report to the final end device delivery must be a good thing. One question does remain, though, and that's whether this earlier announcement that a vulnerability exists will help attackers in some way.

I'm inclined to agree with Willis when he says "reporting transparency is an alert, not a blueprint for attackers". After all, there are no technical details of the vulnerability, there's no proof-of-concept code, and there's no other information that could conceivably help an attacker in any material way, as far as I can see. And, remember, this is only a trial and one, I am certain, that will be closely monitored both by Google Project Zero and Project Big Sleep, the collaboration between DeepMind and Project Zero using large language models to catch vulnerabilities in real-time code, which is using the process in its vulnerability reporting.

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STEVE CASSIDY

"The state of panic around who will own the future of AI is profound"

Whether it's creating robust defences against the rise of AI or the effects of the Online Safety Act on businesses, a sensible approach can be found

I suppose I should be pleased that the mainstream media has finally caught up with some of the observations I've been making about AI for years. Their stories are both late breaking and panic-stricken, and profoundly lacking in practical advice. Advice I aim to give you in this article.

Why the panic? Partly because they conflate several areas of expertise not commonly found in the brain of one person. Technology, yes, that's fine. Infrastructure? Some of those concepts are easily understood, sure. Then there's commercial real estate project modelling: not only a trifle esoteric, but also generally performed by bankers, and we all know how evil they are in modern times, right?

That's the physical side. Now consider the human factor. First, let's add a dollop of international geopolitical meddling, following it up with the type of business modernism that declares AI to be fantastic before anyone's found a use for it. Out of that cauldron inevitably comes a mass of panic-stricken stories that talk of putting millions of people out of jobs and onto the breadline.

Another recent hot topic is power consumption. People are used to the idea that data centres are power-hungry beasts, but have no idea exactly how much power is demanded by the latest AI suites – and how poorly they sit alongside other compute loads in shared environments. Everyone loves to make reference to ChatGPT being a bit thirsty, but who keeps that in mind while typing in your initial query?

It's hard when we lack real, useful information. We are told that a substitution operation, taking a boring Google query and submitting it



Steve is a consultant who specialises in networks, cloud, HR and upsetting the corporate apple cart
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"It's hard when we lack real, useful information"

BELOW Most people have no idea how much power is required by AI

to ChatGPT, results in at least a tenfold increase in the power costs of actually getting a result back over Google's likely per-query power budget. It's probably fair to say that this is a conservative estimate, because the nature of the query/reply cycle is that you're not the infrastructure user. It's the owners of the AI code who get to decide on your behalf just how much effort should be expended in answering your question.

This makes it difficult to take responsibility for your actions: you get your answer back after a while, but you can't say either "speed this up" or "give me first approximations". The problem isn't just about the limits of technology, though. The state of panic around who will own the future of AI is so profound that it is punching trillion-dollar holes in the whole mid-size commercial property banking business. They are so scared by the idea that someone else might have deeper pockets that they are sinking utterly unprecedented amounts of money into the AI centre for Goldilocks: only by spending more than 20 times the lifetime cost of space exploration can they be sure that the upper hand in AI will be theirs.



Speaking as someone with some time spent in the property finance sector, these people are completely crazy. They're putting all their funding into the first-generation AI data centres. When the second, third and subsequent generations of megascale data centres start appearing, those Gen 1 blueprints will instantly become yesterday's news.

If you've built a \$500 million data centre building that breaks even on a constant, 100% load in AI operations, then what happens to your revenue predictions when last year's leading-edge servers are instantly transformed into museum pieces by the march of technology?

There's also the tricky issue of demand. Take-up of AI by consumers is already falling behind predicted norms, and is principally propped up by the no-choice inclusion of services such as Copilot and Gemini in our devices. Some very shaky assumptions about your readiness to have a chatty relationship with your search engine seem to me to be a weak justification for those trillions of dollars.

What to do about it?

So, what can you do? If you're on the supply side, understand the demands of your AI products: some are truly gigantic. Ask yourself if a lower-key degree of attentiveness might be just fine for your needs. Take careful stock of how much know-how your people have retained after making regular use of "suggesting" search engines augmented by AI. This is a bit of a retrofit into a document which hopefully exists already, enumerating your business risks irrespective of how techie they might seem.

AI is split into different tribes, so your first declaration in the business risk assessment is: which tribe do you belong to? With all the fuss about the largeness of large language model AIs, we forget that at the other end of the scale lie loads of tiny AIs with half-inexplicable reflex intelligence. These are unlikely to compete with H Sap for electricity any time soon: adding this subject to the risks document saves a lot of panicky agonising, and will help you to loosen some cash to address other oncoming disasters.

I was going to suggest resisting the sales approaches from AI aficionados, but they know not to target traditional IT people already. AI entry points into businesses are very much a user-population thing. You have to aim for presenting unbiased opinions on the degree of vulnerability presented by any product, not just AIs, and also get



ABOVE Millions of dollars are being poured into first-gen AI data centres

an idea of your colleagues' various levels of stress and nervousness: it's all too common for people to grab on to a tech product when they feel overwhelmed and under pressure, and you're going to have to factor those effects into your thinking, too.

Managing the Great British Firewall for businesses

I can exclusively reveal an insight from my schooldays that may help you understand why my expectations for the newly implemented Online Safety Act are pretty low. At school, we had a "computer laboratory": a room full of Commodore PET computers, to which access was considered quite a perk.

In an early incident of self-destructive behaviour, I managed to develop a determination to be at the keyboard of a computer as often as possible, despite not having a single

"Chief among my detractors at school was a chap called Keir Starmer"

BELOW My old school colleague's grasp of computing is no better now than in the 1970s

science-oriented subject in my selected syllabus. This resulted in me being barred from the computer room quite early on in the school year, and taking some flak from my peers for being bothered by something so unimportant as a computer.

Chief among my detractors in this matter was a chap called Keir Starmer. In many ways he was my diametric opposite when it came to interests. I was sucking up as much computational science as I could find, while he was perfecting his social graces and debating the future of the country with other classmates.

Fast-forward a lifetime, and I find his naivety about computers, computing, software and even mobile phones to be touchingly archaic and unchanged, to say the least. Actually, that's not fair, because he wasn't hot on tech back in the 1970s, any more than he is now, so "archaic" doesn't apply. Perhaps there's an element of wilful ignorance at work, mixing badly with his need to show involvement in the issues of the day.

So we are now living in the age of the Great British Firewall, whether we want it or not. The question to answer is: how does the system actually work, and could there be some unexpected side effects on your business?

Last question first: yes, there certainly could be unexpected side effects. I've been doing very little else this past couple of weeks other than hunting for reasons why previously reliable e-commerce sites have, since the inception of the UK system, stopped working. Many don't even admit that they have a problem.

What seems to be happening is that previously the open flow of traffic across the net meant that payment systems could mix and match their



technology, and traffic, almost transparently. It was possible for a payment processor domiciled in Luxembourg (as many are) to make use of a credit card validator or gateway in Vilnius, on the coast of the Baltic. The whole point of the net is that it's supposed to be locationless. As the designer of your business' cloud services, you can choose not just one data-handling service, but as many as there are stars in the sky. Virtual markets have sprung up, in which the choice of payment partner is an ad hoc thing in the last nanoseconds of the transaction.

This, apparently, is not looked upon well by the Great British Firewall. Starting from a poorly explored brief in "making the internet safe for our kids", the coverage of the whole system thus far has focused on making foreign and dubious sites collect more data on their customers, with a trend developing in getting users to put in their credit card details not to buy stuff, but simply to hitch a ride on the credit card issuer's retention of dates of birth and other personal items.

To say the coverage by the regular media is incomplete is too polite. For one thing, until you fill in the required details there's a mechanism in place that bars your access to the resource you're trying to reach: that might be at the border of the cloud services that comprise the "adult interest" site, but it might also be a lot closer to home, in the shape of a traffic choke installed at your UK ISP which does a three-way check to see if you've been diligent in your desire to look at rude things, and filled in all the right boxes to be granted that access.

I don't claim some deep insight into the architectures of pornographic website server farms, but I strongly doubt that they all use the same load-balancers, protection packages (Cloudflare seems popular) or even HTTP servers. If they're that diverse and far from being co-operative then an in-stream access control system would be the logical way to achieve something that looks like protection, to the inexperienced, parental or safeguarding eye.

The only people who lose out are those who diverge from the classic home web-surfer architecture. That would be us, then: businesses have not been expected to conform to any



national standard in anticipation of some ill-advised crackdown. Looking at the 20 or 30 web-based businesses I've been using in the past few years, I'd say half are in a tizz right now and would dearly love to put up a banner that says "just ring us up to make an enquiry or booking". It turns out that consolidating a multi-service cloud e-commerce host into a single bits-in, bytes-out classical server that can be recognised and even cooked up is not likely to be a rapid process.

Do I hear someone screaming "VPN!" at their copy of PC Pro? If so, I somewhat agree with you. For home users, VPN services that make it look like you're coming from Hanover when you're really in Hull have been a staple solution for poorly thought-out access management for decades now. These are easy to put together when you're alone on your laptop, but become far more complex when you have an office full of PCs, Macs, a three-phase metal sheet-chopping internet-connected guillotine, or even an encampment of activists outside your perimeter fence who think their grievances against your neighbour are good enough grounds to be given the guest password to your Wi-Fi. In those more complex

ABOVE The laudable aim of keeping kids safe online is affecting many legitimate sites

"In complex scenarios, my advice to clients often produces a raised eyebrow"

BELOW Cloudflare is a popular protection package for many "adult" websites

scenarios, my advice to clients often produces a raised eyebrow.

That advice: get a second internet connection. Simple as that. Businesses don't upgrade their links very often, because it's a huge upheaval if you consider it to be a matter of dropping the old link before intercepting the new. But I never like seeing IT managers just making rods for their own back and not thinking laterally enough.

Put in a second pipeline and your existing server and firewall hardware doesn't change one tiny bit. All you're doing is adding another static IP device to the network, which won't even be referred to in the configuration of most of your existing devices. Your old connection and router become used only by servers, which have static IP addresses. Your new connection is used by any device grabbing addresses from your dynamic DHCP pool, be that desk PCs, visiting phones, user laptops or impoverished protesters. By gathering all the real-human traffic on one router, and the business-grade machine-to-machine traffic on another, you can start fiddling around with router-level VPNs and frequent access reboots without messing up on the money. If you have to have different configs for different levels of access (mainly, for example, certificates), then you can be applying those to router B while people are still making money and fulfilling orders on router A.

I've found this to be near-perfect in an imperfect world when the wider architecture of the internet around you changes abruptly for these – or other – reasons. It's certainly less stressful, and doesn't get in the way when a cloud supplier suddenly tells you to use their VPN solution, irrespective of your preferences.

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Retro

Inspirational stories from computing's long-distant past



LEFT Galaksija computers housed in various different coloured cases

The concept of this particular DIY build was envisioned by Voja Antonić, who fell in love with technology from a young age. He began to enjoy HAM radio in the 1970s and got as far as passing exams, earning a licence and getting a call sign. He also became interested in digital technology.

"I was in elementary school when I bought my first transistors with my pocket money," he told *PC Pro*. "They were germanium types AC540, the equivalent of Philips' OC70, and, while I didn't know the theory, I knew I could build digital circuits."

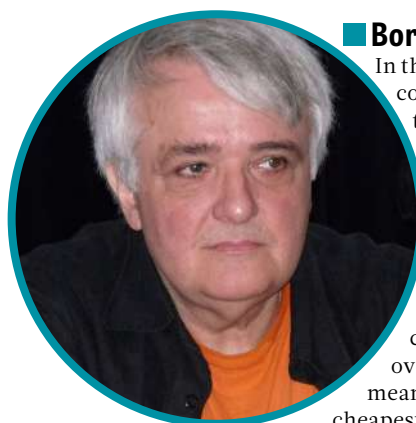
Antonić certainly loved to play around, making his own discoveries. "One base resistor and one collector load and I had the inverter – I 'invented' the flip-flop not knowing that it had been used for decades," he said. He later used a microprocessor

to create a Conway's Game of Life machine. But his ambitions were hampered by Communist

restrictions, which meant that he needed to be creative in his desire to pursue his hobby.

The legend behind Yugoslavia's DIY computer

David Crookes interviews Voja Antonić, the man whose recipe for a home-made computer – the Galaksija – inspired a generation in former Yugoslavia



Born from necessity

In the late 1970s, home computing was beginning to flourish across Western Europe. Apple impressed with the Apple II and Atari released the 400 and 800, but tech enthusiasts in Yugoslavia couldn't buy such machines. "Computing was not limited but you couldn't import anything over 50 Deutsch Marks. It meant you couldn't get even the cheapest computer on the market," Antonić said, believing such restrictions were leaving people in his country many years behind.

There were means, however. "You had the choice of smuggling one into the country or building your own," Antonić said. So he effectively did both. He asked a friend in the US to break up a new TRS-80 Model I microcomputer in 1977 and have it sent to him in pieces in multiple packages, labelled as "technical junk".

ABOVE Voja Antonić's work in the Socialist Federal Republic of Yugoslavia was ground-breaking

It was December 1983, and Belgrade in former Yugoslavia was suffering a typically harsh winter. Temperatures had plummeted to as low as -10°C . Yet something happened that month which would warm the hearts of thousands of technology enthusiasts: a special edition of a popular science magazine hit the shelves.

The publication, *Računari u vašoj kući* (Computers in Your

Home), was released as a spin-off of the monthly magazine *Galaksija* and it was notable for two things. One, it was the first computer magazine to be released in the country. Two, it instructed readers how to build their own computer. What's more, it became as influential in Eastern Europe as the ZX Spectrum and Commodore 64 were in the West. What began as a small project became a phenomenon.

When Antić received all of the packages he rebuilt the machine, thereby getting around the restrictions. Years went by as enthusiasts continued to resort to smuggling, bribing and coming up with innovative and creative ways to get kit into the country. Many became accomplished engineers and programmers in the process, with Antić himself becoming adept at creating computers and developing software from scratch. But there was a widespread feeling of frustration.

Antić, like many others, was hearing about new machines being released in the West and he was envious of their capabilities. The ZX Spectrum, for example, had a custom chip called the ULA (Uncommitted Logic Array) which could, among other things, generate a display with the assistance of a UHF modulator.

When producing his own computer, he knew he wouldn't be able to add a ULA so he came up with an alternative plan. He figured he could use part of a Z80 microprocessor to generate the fastest portion of a video signal, allowing software to generate the slower portion. This would allow him to produce a computer without a graphics chip, even though he knew it would sacrifice processing power.

Once he got that aspect of his computer working, he was able to work on producing an operating system, as well as a line editor and BASIC interpreter.

"I produced something that was well optimised and simple to build," Antić said. "Yes, it was slow with only 4K of operating system and 6K of RAM. It also had 16 x 32 text and very poor graphics (64 x 48), but it was still a computer."

Blueprints for a generation

Antić decided the computer was too good to keep to himself. "I thought there might be others who would want to build it too so I wanted to offer it to a magazine," he said. He considered approaching *SAM Magazine* in Zagreb, believing his prototype computer would be of interest to its readers. But a mutual friend put him in touch with journalist and computer programmer Dejan Ristanović, who had just happened to pen a piece about general computing for *Galaksija* magazine.

As luck would have it, following the publication of his computing article, Ristanović had been asked to oversee a 100-page special edition called "Računari u vašoj kući", and he was looking for interesting ideas. Such as Antić's machine. The idea was to devote a reasonably large



number of pages to the computer, showing readers exactly what they needed to do to build their own version.

Antić had five months to tweak and perfect the build. During that time, he finalised the firmware and worked hard to ensure it could be squeezed into the desired 4KB of EPROM space. At no stage did he pretend his design could rival Western machines. That wasn't the point. But he was excited at the prospect of introducing scores of people to computing, giving them a taste of what many outside of Eastern Europe were enjoying.

"The computer's performance was extremely poor, but the ease of assembly and the price were good enough to motivate you to build one," Antić said. "The design philosophy was also simple: a computer made by your own hands. Once I'd offered it to the magazine, everything else was a coincidence: the fact it was a good moment to start something like that and the fact there were two good guys – Dejan Ristanović and Jova Regasek [*Galaksija's* editor] who took action and published the DIY project."

"The performance was extremely poor, but the ease of assembly and the price were good"



Crucial to the project was availability. The computer – which was also called Galaksija ("Galaxy" in English) could be created in its entirety using easily obtainable parts, and that made it both legal and attractive. The article told readers where they could

get the components from – whether that was in a store, via mail order or from suppliers abroad – and they were able to mail their EPROMs to be loaded with the operating system.

Since Antić sought to use as few components as possible, readers didn't have to spend

too much time finding parts, and it meant the computer was also affordable. "The software-assisted video saved a lot of integrated circuits – counters, selectors and buffers – so the whole project only had 14 basic chips around the processor and memory," he said. "This came at the cost of slowing down the computer to only 25% of its initial computing power, but no-one cared."

The people's computer

Just before publication, Regasek was curious. He asked Antić how many readers he believed would actually take the time to build it. "Even when the whole article was ready for print, with lots of photos and 16 pages of text in the magazine, my guess was about 50 successfully built pieces," Antić said. "Dejan estimated about 200 and Jova about 500." All of them were wrong.

The article was hugely popular, so much so that the magazine quickly

TOP You can play Russian favourite Tetris online in a Galaksija emulator

MIDDLE Pages from the magazine with instructions on how to build the Galaksija

ABOVE The Galaksija introduced lots of young people to the delights of computing

sold out. It needed to be reprinted, but those copies sold out too. Regasek ordered a second reprint, then a third, and then a fourth. *Galaksija* magazine sold 30,000 copies but *Računari u vašoj kući* ended up selling more. Four times more.

"After a very short time, we had more than 8,000 letters from enthusiasts who built it, so there must have been more than 10,000 built across the country," said Antić. It was nothing short of a triumph and it helped to spark a computer revolution that would, in many respects, rival that of the BBC Micro in the UK. Suddenly, people were able to see the potential of computers. For many, it felt liberating.

"People were ready to embrace computing as a new era, and that was the main reason for its success: a lucky moment to start a DIY project," Antić said. It also started a cottage industry of sorts. "You didn't have to wait long before smugglers started offering complete kits with printed circuit boards and even programmed EPROMs, which meant problems with some supplies were automatically solved," he added.

Most kits wouldn't come with a keyboard or a case. Users would have to provide their own, which meant that *Galaksija* machines took on unique identities. People would be creative and innovative, decorating their computers to suit their own personalities. This meant that the *Galaksija* computer felt hi-tech yet primitive at the same time, and it likely helped to demystify the machines.

There was also plenty of software. Users would load and save from cassette tape – a potentially painful experience as many readers will know. But it made copying easier, and the aim was to encourage people to share their creations rather than seek to profit from them.

One way people could obtain software was to tune into the state-owned Radio Beograd 202, which broadcast from Belgrade. If you ever remember taping your favourite Top 40 songs at home, then the concept was similar: a radio host called Zoran Modli would broadcast computer software on his Ventilator 202 show and people would record them to play on their *Galaksija*. Hundreds of apps were distributed this way, and enthusiasts would send their own programs to Modli. There were many games.

The fun wasn't to last, however. Although an improved version called *Galaksija Plus* was created by Nenad Dunjić in 1985 with an enhanced 256 x 208 monochrome display, 48KB RAM and three-voice

"I still get emails from people all over the world, mostly from guys from the former Yugoslavia"

sound, the excitement around *Galaksija* began to fade. It had made its way in to homes and some schools and universities, but other, more important, things began occupying people's minds.

"There was a political crisis with extreme nationalists in the government, then came the war and mass protests, even NATO bombing of major cities in Serbia. There wasn't much room for such projects," Antić said.

■ A second life

For a time, *Galaksija* was even derided, especially after Western machines eventually made it into Yugoslavia's domestic market. "There was a moment, especially during the war in 1990s, when *Galaksija* was followed by a bad connotation," Antić said. "You could read the jokes about it, mostly based on the modest performance of the hardware. But somehow everything changed after the turn of the century. I don't think that I can explain it."

Call it nostalgia or simply a recognition of the *Galaksija*'s true worth, but the computer found a second wind. In some respects, its story mirrored what happened in the West: old machines were cast aside in favour of new ones, only for some people to later return to them with fondness, leading to a flourishing retro scene.

"The new century began with a rebirth of technical enthusiasm. People suddenly became interested in the history of computing," Antić said. "Soon I got calls from several museums to donate copies of *Galaksija*." He also learned that the project helped to

seed a generation of developers, engineers and makers across what is today Slovenia, Croatia, Bosnia and Herzegovina, North Macedonia, Montenegro, Serbia and Kosovo.

"I still get emails from people all over the world, mostly from guys from the former Yugoslavia," Antić said. "They told me that I had determined their future, because their experience building the *Galaksija* encouraged them to continue studying digital hardware and software."

Even those who didn't forge a career in computing remember the *Galaksija* with fondness. "When I'm in Belgrade, there are people who stop me on the street to share a few words with me about those days," Antić said.

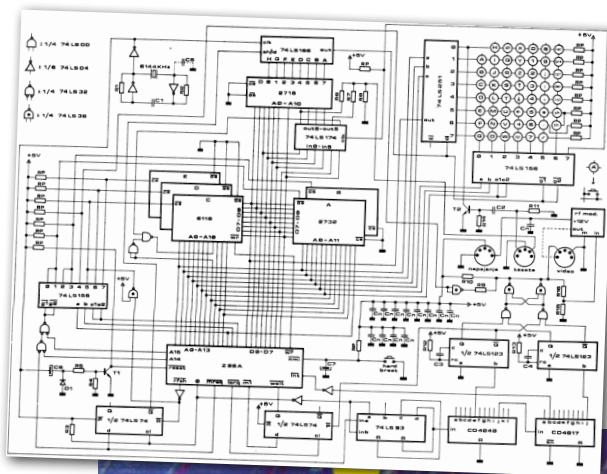
Yet even though he helped shape the future of computing in former Yugoslavia, Antić wishes today's industry reflected more deeply on its origins. For while he looks back with great fondness on those early days and acknowledges the progress made, there's also a desire to return to simpler times.

"Today's games are fascinating, but they are also too different from the old ones," he said. "I wish they

could replicate the charm and beauty of the old 2D computer games." But it's no surprise. If anyone can remind us that even the simplest sparks of curiosity can change lives, few serve as a better example than Voja Antić. ●

BELOW *Galaksija*'s circuit diagram was printed in the magazine for readers to follow

BOTTOM This image was used on the cover of the January 1984 issue of the magazine



Futures



Language is always changing, and nowhere does that happen faster than with teenagers. But forget them and whatever the heck “skibidi” means: there’s a flood of new words in the world of tech, too, thanks to the rise of AI and other future innovations hovering on the horizon.

“Technology is bound to be an important driver of ‘lexical innovation’ – linguists’ jargon for new vocabulary – when new concepts, processes and products are not encoded by our existing lexicon,” said linguist Tony Thorne, the author of *Dictionary of Contemporary Slang*.

Clankers, glazing, vibe coding – these aren’t just relevant to IT but to everyone, notes Thorne. “AI has generated a whole raft of new terms, and many of these are escaping the purely specialist environment and are becoming familiar to a general audience,” he told *PC Pro*. “‘Hallucinations’ in its new incarnation, for example, and now even ‘vibe-coding’, is understood by many in the wider world. ‘Slop’ never seemed like a particularly witty or clever usage, but of course it’s super-relevant and has spawned derivations like ‘ultraslop’, ‘retroslop’, even ‘slopfrastructure’ and ‘slopsquatting’.”

Understanding such jargon matters, as some terms seem designed to obfuscate innovation for the general public. Consider the use of “hallucinations” in AI, which are merely to-be-expected inaccuracies in AI systems that have no sense of truth.

“It’s actually a responsibility to ensure that a general public can make sense of rapid change, tech innovations and digital media, and to talk about these things honestly,” Thorne said. “Politicians, developers and commercial interests can’t be trusted to manage new technology responsibly, and even watchdogs and official oversight bodies – and mainstream media too – seem incapable of informing and protecting consumers.”

Thorne says we need more vigilance when it comes to tech terminology. “The way we choose the language to describe or promote new technology is important not only because we should avoid mystification or excessive technicality if we can, so that non-specialists can decode the terms we invent, but also because this language sometimes becomes part of new and controversial activities.”

Here’s our glossary of the future to help you decode everything from “algospeak” to “vibe coding” – so when you hear these terms in meetings, you’ll be able to figure out what the C-suite actually wants.

Glossary of the future

What does it all mean?

The advent of AI has sparked a thesaurus full of new tech jargon. Here’s what some of it means, according to **Nicole Kobie**

Agentic AI or AI agents These versions of AI can actually take action, rather than merely generate reams of text or quirky images. Thankfully, because AI remains stuck in our computers that action is largely limited to navigating the web and filling out digital forms. If these agents work, AI might become useful for taking over our digital drudgery. At least until they take our jobs.

AI washing Marketing your product as having AI when it doesn't really, or only in a limited way. You know how every company claims to be AI native or AI first these days? That. *See also:* GPT-washing, jumping on the bandwagon, AI hype, every day since ChatGPT arrived.

Algospeak According to Adam Aleksic's new book on the topic – aptly named *Algospeak* – this refers to words created to evade algorithmic censorship on social networks, or any term otherwise shaped by algorithms. For example, Chinese-owned TikTok didn't like users chatting about death or other related topics; instead, they switched to the term “unalive” to dodge algorithmic controls. *See also:* leetspeak, euphemism treadmill.

Artificial general intelligence Commonly referred to by its acronym AGI, this is a term with an always shifting meaning. DeepMind co-founder Demis Hassabis says it means AI with “human-level cognition”; OpenAI CEO Sam Altman says AGI is “the equivalent of a median human that you could hire as a coworker”, though in his company's contract with Microsoft it's defined as when AI can make \$100 billion in profit. *See also:* shifting goalposts.

Bare-minimum Mondays The opposite of starting as you mean to continue, this TikTok work trend is all about easing into the work week by spending the first few hours of your Monday organising yourself (read: doing laundry) and strategising (read: taking a nap) rather than feeling flustered (read: doing work). *See also:* Sunday scares, lazy-girl jobs, quiet quitting.

Brain rot This internet slang is applied to low-quality digital content, often found on social media, which is useless yet weirdly addictive, as well as the cognitive decline caused by such material. *Used in a sentence:* “I got tired of

doomscrolling, so tried to relax with brain rotting instead – that was a skibidi move.” *See also:* doomscrolling, bedrotting, lay down and rot (LDAR)

Broligarchy A portmanteau of “bros” and “oligarchy”, this trend relates to tech billionaires wielding their power over society and politics, and found its perfect example/nadir in Elon Musk's foray into the United States government with DOGE. *See also:* techno-feudalism – how the world has always worked, but with this time around terrible fashion sense.

Clanker A derogatory term for AI or robots, derived from the *Star Wars* cinematic universe. *Used in a sentence:* “I called customer service, but there were no humans to talk to – just clankers.” *See also:* wireback, cogsucker, tin can.

Cloud repatriation Remember back when servers were physical devices in the building, rather than something you accessed via AWS? Well, the good old days are back! Companies angry at cloud costs and their unpredictability are re-investing in their own on-premise systems again.

Context window How much an AI model can think about or remember, sort of like its memory. A wider or larger context window means more information can be considered, leading – hopefully – to improved accuracy. *Used in a sentence:* “If you want a larger context window, you'll have to sign up for a paid subscription.”

Decel Short for decelerationist, a derogatory term for those who think AI development should be artificially slowed down to help avoid, or help us humans prepare for, all the dangers that AI-developing companies keep warning us about, like an existential threat to humans.

Delve A signifier for AI content, “delve” is one of a handful of words that generative AI systems use more than we humans, so its appearance suggests AI writing. Of course, some people do actually use that word, and now that AI uses it frequently, humans are probably going to start using it more, sparking a spiral of “delve” overuse that means we can no longer use it to spot machine-generated words. Another example is the punctuation device known as

the “em dash” – beloved of professional writers, including this one, which is probably why AI uses it so much.

De-monetisation When influencers are shadow-banned by the algorithms, reducing how much their content is shown to would-be viewers, hurting their chances to push unnecessary products to their followers. It's being digitally cancelled, but just on socials.

DePIN Short for decentralised physical infrastructure networks, this is blockchain in the real world, a way of applying that as-yet not very useful innovation to manage and control real-world assets such as sensors or edge computing. It's the internet of things meets crypto. Yes, we know.

Digital sovereignty The US is no longer trustworthy – if it ever was – so it's time to invest in our own cloud, AI or other technical services that are in our physical control; essentially, this means local data centres. Alternatively, a way to get Microsoft, AWS, Google *et al* to invest in local infrastructure. *See also:* cloud sovereignty.

Techno-feudalism: how the world has always worked, but with this time around terrible fashion sense

Echoborg When a human's speech is entirely scripted or determined by an AI, this originally referred to a research technique for social psychologists but now also explains why the person that applied for that entry-level graduate role took ten seconds to reply after every question in the Zoom interview and said “delve” three times.

Frugal tech Sustainable, affordable innovation that's designed to benefit people, frugal tech is seen as an antidote to the dominance of Big Tech, broligarchs and Silicon Valley. *Used in a sentence:* “I read a great feature about frugal tech in *The Guardian*, but still bought the new iPhone.” *See also:* calm technology, dumb tech.

Generalisability An as-yet-unrealised goal for automation, in particular driverless cars,

generalisability means a technology that can be used anywhere without much – or indeed any – localisation effort. For example, a self-driving car trained heavily in San Francisco could hit the streets in LA without years of work and billions of dollars in additional investment. Or a humanoid robot could see the dishwasher needed emptying and figure it out without smashing the crockery. *See also:* unicorns.

Generative engine optimisation

Like search engine optimisation (SEO), but GEO is targeting the attention of AI-powered search rather than humans. Bots talking to bots all the way down. *See also:* dead-internet theory.

GitOps

DevOps, but on GitHub. Similar insider-indicating jargon built on the DevOps style includes ChatOps, LLMops, ModelOps, MLOps, AIOps and really anything else with too much hype. All seem to be leading to NoOps, which removes humans from the loop using automation, though there's pushback via HumanOps. (That was initially written as a joke but appears to be a real thing.)

Glazing When an AI sucks up to you by saying your writing or ideas are really awesome, in a bid to keep you using the machine. "That's a great question, Hal." *See also:* sycophancy, AI psychosis.

Guardrails Rules built into an AI system in an attempt to prevent it from spitting out scary responses, such as violent, biased, overly sexual or racist images and text. After all, being nasty is a job for us humans.

Hallucination A dramatic way to describe generative AI errors that suggests inaccuracies are mistakes rather than a key indicator of how these systems actually work, which is by making things up. *Used in a sentence:* "We've made significant advances in reducing hallucinations, improving instruction following, and minimising sycophancy," said OpenAI announcing GPT-5.

Native Not an acknowledgement of indigenous rights, but a way to jump on the technology bandwagon in order to sound ahead of the curve; useful for AI-washing. When the backlash against future tech begins, we'll surely be talking about "human-native" systems.

Used in a sentence: "Our AI-native security app used to be called cloud-native, but marketing told us this would sell better."

Meeting recovery time A measure of how long it takes to get back to actual work after a meeting. This is why you get so little done on days with too many Zoom calls or all-hands. *See also:* Zoom fatigue, meeting-free mornings/days.

p(doom) The probability of doom or hope, or how likely you think AI will prove an existential risk and kill us all. *See also:* AI Doomerism, decelerationists.

Prompt engineering Learning how to talk to the machines so they understand what you actually want, despite the fact these are language models designed to work with natural speech. *Secondary definition:* your new job. *See also:* prompt tuning, tweaking until you get it right.

RTO An acronym for "return to office" that is usually accompanied by a "mandate", an RTO is a demand from management to get out of your pyjamas and commute to headquarters rather than work from home as we have all successfully done since lockdown. The opposite of hybrid working, RTOs are big in banking circles – the money needs to be babysat in person, it would seem – and increasingly so in technology. *See also:* presenteeism, micromanagement, nostalgia for a long lost but not missed style of working.

Scope 3 emissions Emissions from a company are broken down into three types: Scope 1, or direct emissions; Scope 2, indirect emissions, such as the electricity used; and Scope 3, which are supply-chain emissions. The latter sound like they're someone else's fault, but when it comes to Big Tech this is where big rises in emissions are found: Google's Scope 3 includes the production of technical infrastructure such as hardware for AI and has increased by 22% year on year. *See also:* greenwashing.

Shadow A way to describe a technology or tool that's been snuck into a company under IT's nose without consideration of the potential risks. That includes shadow AI, and the original, shadow IT. *See also:* letting ChatGPT do your work for you.

Shift left Not a political reference – sorry, Jeremy Corbyn – but the trend of moving security considerations or other features earlier into the development lifecycle of software. *See also:* Secure by design.

Slop The garbage content spat out by AI that's now clogging the internet, social media and our work lives. And, in turn, worsening AI itself. Often comes in the form of unfunny memes – weirdly often including babies for some reason – but can be applied to almost anything churned out by generation bots. *See also:* slopification, enshittification

Slop: The garbage content spat out by AI that's now clogging the internet and social media

Synthetic data AI models need to be fed data for training, but there isn't always enough of the right type, so AI can be used to generate synthetic data to show that system in training. That makes sense with, say, driverless cars, as accidents or other extreme, rare incidents can be manufactured to show the AI model so it knows what to do if and when it happens in real life. But it could also mean AI-generated material is being used to train an AI to make AI-generated material, and it all gets a bit too meta for us. *See also:* model collapse, digital inbreeding

Synthetic workforce When all employees are clankers. *See also:* ghost knowledge worker, virtual human.

Trendbait Aleksic defines this annoying trend as saying something in a social post in the hopes of sparking responses to go viral. *See also:* ragebait, clickbait, the entirety of social media, tabloid headlines.

Vibe coding Coined by Andrej Karpathy in early 2025, vibe coding is the use of AI to create an app or other software, writing the code itself based on user prompts alone. Tell an AI what you want, it writes the code, even if you don't know how – *especially* if you don't know how. ●

PC PRO

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"Well, PCPro reader, you'll find out all the latest features that I now offer, so if you're still using me as a glorified alarm clock then make sure you pick up a copy of the magazine."

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Find out if the paid-for suites from Avira, Bitdefender, McAfee, Norton and many more can justify the outlay compared to the free service provided by Microsoft.



Retro

Andy Grove: the man who transformed Intel

You may not know the name, but *Time* magazine declared Andy Grove as its man of the year in 1997. We explain his impact and why Intel wouldn't be where it is now without him.



The Network



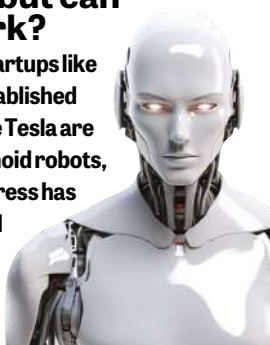
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The next technology breakthrough will be sensational, says Jon Honeyball

Wandering around the show halls of IFA this month (see p32), I was struck by how big some aspects of our industry expect smartglasses to be – and by how blind they are to exactly how bad their current offerings are.

I don't care how much proponents claim otherwise; most offerings fall apart as soon as you look at the reality of their designs. This isn't a criticism of the designers: the problem is that the technology we need to make this format really work is several generations ahead of us. The components required to produce a truly useful, immersive AR experience do not yet exist. For consumer electronics firms, the sensible thing to be doing right now is working on the fundamentals of the OS and development platforms, so that we're ready when that breakthrough technology finally breaks through.

There are other challenges, too. Not everyone is accustomed to wearing glasses for long periods of time: according to Perplexity, 61% of the age group 25–34 regularly wear glasses, while Copilot suggests around 20%. That huge variance probably says something about how much we should be trusting AI, but even if the higher figure is correct, that means nearly half of the population don't habitually wear spectacles. That's a lifestyle issue that smartglasses are going to need to overcome.

There is an argument that even people who don't need corrective eyewear will wear glasses as a fashion statement, or sunglasses when outdoors. But a solution that relies on visual inputs needs to be wearable all the time, by those who don't wear glasses today. It also needs to work equally well for those

who do wear glasses today, because they need corrective lenses.

The all-day aspect is also problematic. Battery life has to exceed a waking day; six hours won't cut it. Having to continually swap back to your basic specs so that the smart ones can go on charge will grate badly.

But the most important question is how smartglasses are going to fit into the larger web of technology. Because we don't need yet another standalone gadget: we need a fabric of solutions, all working together in a variety of ways. I have that today with my Apple Watch, my phone and CarPlay. Adding in an always-in-view visual element could be enormously useful, as long as smartglasses can provide a significant value-add that makes them worth buying and wearing, versus just pulling my phone out of my pocket.

To continue that thought, at some point I can see smartglasses becoming good enough that I could entertain a future iPhone with no screen on it. Repackage the phone, turn it into a communications hub that's compact enough for me to comfortably mount onto my belt or keep in my man-bag, preserving the crisp lines of my dinner jacket ensemble.

This is what makes Apple's recent announcement of live translation with its newest AirPods so interesting. Live translation itself isn't a new idea, of course: several other companies have been trying to break this market for some years, and will doubtless now go home crying. But what excites me isn't just this specific application, but the mass-market productisation of smart voice interactions, in ways that the proverbial Person on the Clapham Omnibus hasn't experienced yet.

We're ready for an explosion of display-free, speech-oriented capabilities. Already I can control many capabilities of my phone by simply talking to it, and that's only going to grow. Where specific graphical capabilities are required, I can get that presented to me on my watch. If I'm driving, a suitably non-distracting user interface can be manifested via the CarPlay or Android Auto interface.

And this brings me to a further realisation. So far, almost every attempt I have seen at creating smartglasses has been focused on making the technology work. This is

“The task must be to get the technology to enhance and enrich my life, such that I forget it's there”

the wrong way around: the task must be to get the technology to enhance and enrich my life, such that I forget it's there. Forcing me into cul-de-sacs of sandboxed capabilities, which require me to change the way I go about my day to satisfy the limitations of the platform, will result in failure every time.

Meanwhile, I'm looking forward to my next business trip, when “I'll have the boeuf bourguignon please – can you recommend an appropriately robust red?” will be automatically translated into German, Japanese or Korean. Only for the waiter to suggest: “The Opus One 2021 would be an excellent match” – in perfect English, of course, since the rest of the world is better at speaking it than we are.

■ Jon Honeyball is a founding editor of *PC Pro* and a regular on the *PC Pro* podcast. He looks forward to playing *Doom* while shopping at Tesco. Email jon@jonhoneyball.com



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CPU: AMD Ryzen 7 9800X3D 8 Core

GPU: AMD Radeon 9070 XT 16GB

RAM: 32GB DDR5 6000MTs

SSD: 2TB M.2 NVME Ultra-Fast SSD

CASE: Gamdias NESO P1 Pro Case

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